AN ANALYSIS OF POSTWAR INDUSTRIAL BUILDING LOCATION IN THE BOSTON METROPOLITAN AREA

by

James R. Gardner

B.Arch., Univ. of Southern California (1951)

Submitted in partial fulfillment of the requirements

for the degree of Master in City Planning

at the

Massachusetts Institute of Technology

(1953)

Head, Department of City and Regional Planning

Thesis Advisor

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ABSTRACT OF THESIS

Title: AN ANALYSIS OF POSTWAR INDUSTRIAL BUILDING LOCATION IN THE BOSTON METROPOLITAN AREA.

Author: James R. Gardner

Submitted to the Department of City and Regional Planning on January 21, 1953, in partial fulfillment of the requirements for the degree of Master in City Planning.

Objectives:

A. To determine the distance from the center, the direction, and the magnitude of industrial building construction during the years 1946 through 1951 in the Boston Metropolitan Area; and to investigate the relationships between this locational pattern and the general patterns of population and existing industry.

B. To investigate the relationships between the locational pattern of the largest of these projects (29) which located on new sites and factors peculiar to the industries and factors peculiar to the areas of location.

Findings:

A. In the Boston Metropolitan Area during the years 1946 - 1951:

1) Most industrial construction took place within the area 6 to 15 miles distant from the metropolitan center.
2) The largest projects, in general, were located outside a 6 mile radius of the metropolitan center.
3) The dominant direction in terms of new industrial construction was West.

B. The strongest relationships of "industrial factors" to distance from the metropolitan center were with:

1) Intensity of land use.
2) Type of product
3) Level of building investment.

Conclusions: Material gained from this kind of study is of value in the process of Metropolitan Planning. This analysis would be of significance, either as a component of a more comprehensive research study or as a companion study to others in a comparative analysis with other metropolitan areas.

Thesis Supervisor

Roland B. Greeley
Associate Professor of
Regional Planning

369 Westgate West
Cambridge 39, Massachusetts
January 21, 1953

Professor Frederick J. Adams, Head
Department of City and Regional Planning
School of Architecture and Planning
Massachusetts Institute of Technology
Cambridge, Massachusetts

Dear Professor Adams:

I submit An Analysis of Postwar Industrial Building Location in the Boston Metropolitan Area as my thesis in partial fulfillment of the requirements for the degree of Master in City Planning.

Respectfully yours,

James R. Gardner

ACKNOWLEDGEMENTS

The author wishes to acknowledge his indebtedness and express his sincere appreciation to:

Professor Roland B. Greeley for his advice and assistance.

Mr. Joseph King of the Massachusetts Department of Labor and Industries and his staff for aid in obtaining much of the statistical material used in this study.

My wife, Terese, for her aid in preparing this presentation.

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OBJECTIVES

It is the purpose of this study to determine for the years 1946 through 1951 the direction, distance and magnitude of new industrial location in the Boston Metropolitan Area and to evaluate certain factors which have influenced the result of six years of this industrial location. In other words, it is an attempt to describe in more precise language the widely discussed phenomenon of "industrial decentralization" as it relates to the Boston Metropolitan Area.

Obviously decentralization has taken place and is at present occurring in the Boston Metropolitan Area. Some results of the apparent loss in the central city and of the gain in outlying areas have already been observed. It has yet to be demonstrated clearly, however, to what degree quantitatively this decentralization is occurring or has occurred since the end of World War II. It is not the purpose of this study to explore the broader social and economic causes and effects underlying and accompanying this process. Rather, one of the objectives is to determine <u>how</u> it is occurring once it is initiated, i.e., where in the Boston Metropolitan Area and to what extent.

The co-objective, an analysis of certain of the factors influencing this selective process, is a valid adjunct to the more objective review of the physical examples resulting from location selection. It is true that many of the factors which are discussed in relation to this location activity may often be basic reasons for decentralization per se, but for the purposes of this study they are analyzed only in relation to their effect on more precise site selections, which relationship will in turn dictate the overall future metropolitan industrial development pattern.

The selection of the six year period following World War II for analysis was made primarily for two reasons. Although the change in

industrial location patterns as generally observed throughout the United States has not been an "overnight" phenomenon and has been noted and recorded before the beginning of World War II, it has apparently received its greatest impetus during the post-war years. Relaxation of wartime building restrictions and the availability of expansion and venture capital since the war, among other factors, have contributed to a more "normal" climate for this particular industrial activity and thereby made this a better period for observation and examination. In addition, those responsible for the location of new industrial development were relatively free to choose locations wherever they found them to best fulfill their particular requirements during this time. The national dispersal policy had yet to become an effective influence.

Along with the necessity for as nearly normal a period of time as possible and the desirability of making the analysis as current as practicable, it was felt that a relatively short period would lend itself to more detailed study and valid conclusions.

PART I

An Analysis of The Relationship Between The Pattern of Industrial Location and Population and Existing Industry

Section 1. METHOD

A. Selection of Study Area

Planning District number 5, as designated by the Massachusetts State Planning Board, was chosen as the overall area for this analysis of the relationship of industrial development to Metropolitan Boston. It was decided that this designation most closely represented the geographic area over which Boston exerts the most direct influence and attraction. While the limits of this study area include towns which to a discernible degree are found to be affected by other relatively large industrial concentrations such as Worcester, Lowell-Lawrence-Haverill, and Providence, these municipalities do, to a greater extent, respond to influence originating from the city of Boston and its more intensive industrial, commercial, and cultural development.

The study area is comprised of 100 cities and towns having a total area of 1355 square miles and a population in 1950 of 2,606,700. This compares with 65 cities and towns as designated by the 17th United States Census to be the Boston Metropolitan Area and which had a total population of 2,369,986.

B. Division of Study Area

In this analysis the BMA (expanded Census designation of the Boston Metropolitan Area) has been divided into rings and sectors both for convenience in statistical comparison and for providing a basic structure for use in determining and describing direction and geographic trends and

patterns. While exceptions were made in a few cases in order to obtain a more logical and useful geographic pattern, the rings were primarily determined on the basis of population density, the ranking of each municipality in this characteristic as it related to the whole. The irregular shape of the lines was dictated by the necessity of following political boundaries in order to utilize effectively the municipal data which were available. This division is shown graphically on Map 1, page 5. The rings are as follows:

1. - Central Ring (Core) - Comprising 5 cities, Boston, Cambridge, Chelsea, Everett, Somerville, and the town of Brookline, which was included due to its geographic envelopment by Boston, Ring 1 has nearly 45 percent of the total population; 5 percent of the metropolitan area; contains 5 cities which ranked in the first 5 in population density in 1950, and which in 1945 had roughly 50 percent of the BMA industrial activity. The average width of this ring from the center of downtown Boston is 6 miles.

2. - Intermediate Ring - Comprising 45 cities and towns,[1] Ring 2 had 45-1/2 percent of the total population; 35 percent of the total metropolitan area; contains, with the exception of 7 municipalities,[2] cities and towns ranking in population density between 5th and 50th in 1950 which in 1945 had approximately 40 percent of the industrial activity of the BMA. The average distance of the ring periphery from the center of downtown Boston is 15 miles, and the average width of the ring is 9 miles.

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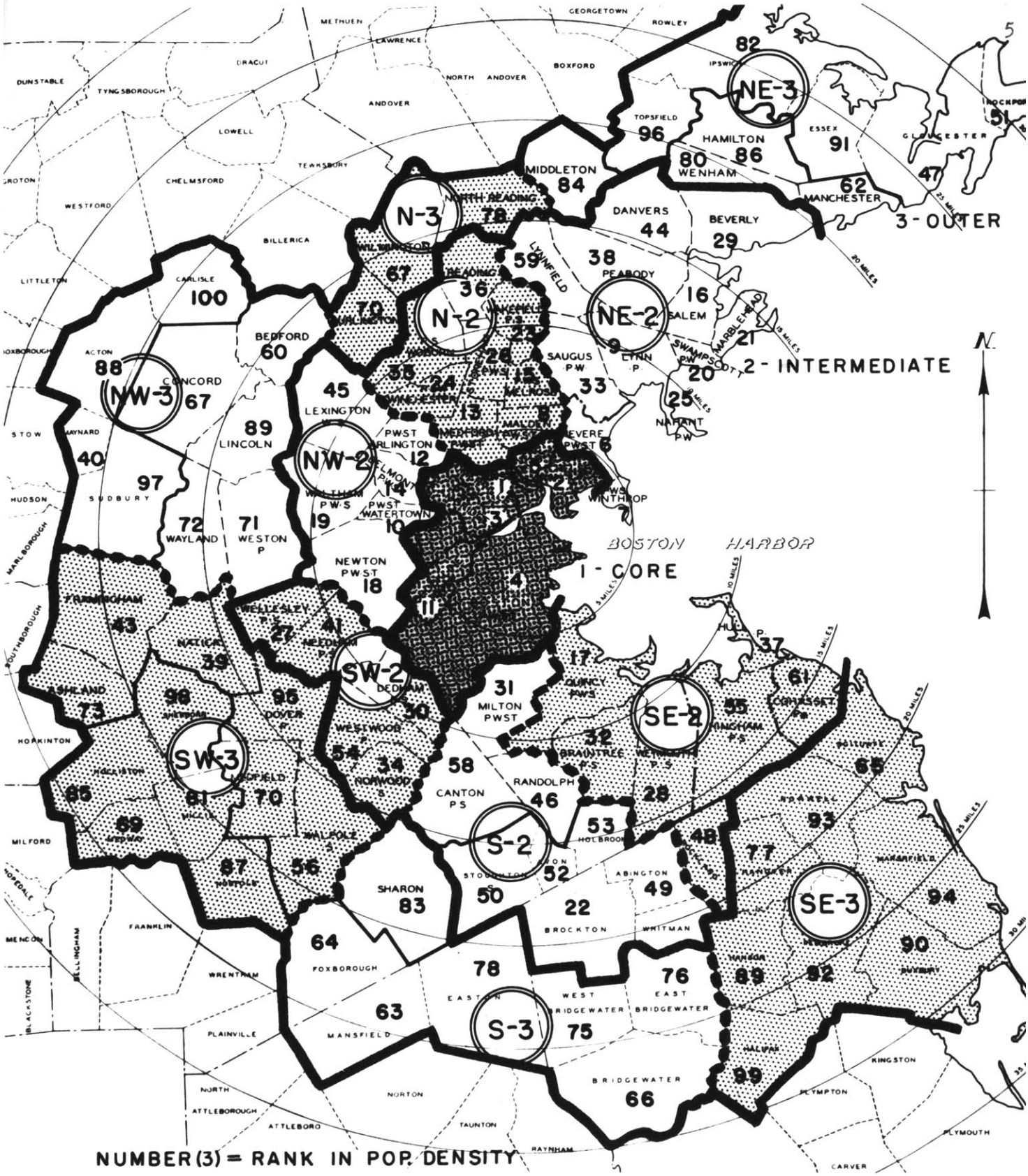
1) See appendix, page 51 , for division of municipalities by rings.

2)

Rank	Rank	Rank
Avon - 52	Hingham - 55	Westwood - 54
Canton - 58	Holbrook - 53	
Cohassett - 61	Lynnfield - 59	



MAP 1

DIVISION OF BOSTON METROPOLITAN AREA

RINGS, GROUPS AND SECTORS

3. - Outer Ring - Comprising 48 towns and one city (Gloucester), Ring 3 had 9-1/2 percent of the total population and 61 percent of the total metropolitan area; contains, with the exception of 4 municipalities,[3] cities and towns ranking in population density between 50 and 100 in 1950 and which in 1945 had approximately 10 percent of the metropolitan industrial activity. The average distance of the ring periphery from downtown Boston is 23 miles and the average width of the ring is 8 miles.

The outer two rings, 2 and 3, have been further subdivided into more or less geographic units (Groups) which are composed of varying numbers of municipalities, one of which is in most instances considerably more dominant industrially than the others. By combining Groups 2 and 3 in a compass direction Sectors were formed. Of the 6 Sectors all but the Northern have approximately the same area. This exception is due primarily to the very close proximity of its boundary line to the Lowell-Lawrence-Haverill concentration and the resulting contraction of the line along this region of dual attraction and influence.

While having greater population counts numerically in 1950, the three northern Sectors experineced less in percentage of population gain during the period 1945 - 1950 and have contributed to a lesser extent than the southern three Sectors to the total metropolitan population increase. Available data, obtainable only on a municipal level, did not permit a sector division of the Central Core. The following are the Sectors, their leading industrial municipalities, and their population characteristics.

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3) Rank

Framingham - 43
Gloucester - 47

Rank

Maynard - 40
Natick - 39

Sector Divisions

SECTOR	Dominant Ind. City	% Total Met. Area	% Total Met. Pop. 1950	Dens. / sq. mile 1950	% Pop. Gain '45-'50	% Total BMA Pop. Gain
No. East	Lynn	17.4	14.1	1550	6.7	4.6
North	Malden	7.6	8.7	2455	31.2	5.7
No. West	Waltham	15.8	10.7	1400	15.5	13.6
So. West	Norwood	17.2	6.1	690	25.9	16.9
South	Brockton	19.6	7.	687	13.	7.6
So. East	Quincy	18.4	7.4	763	30.6	17.7

C. Statistical Sources

Two sets of industrial data have been employed in this study. The first type, obtainable at the time of this study only up to and including the year 1950, reflects the general industrial picture in the BMA. The other, available up to and including 1951, better indicates the actual areas and amounts of new construction and also locational changes, one of the prime objectives of this analysis.

In order to determine the general industrial picture for use as a base for comparison, the statistical material available from the Division of Statistics of the Department of Labor and Industries of the Commonwealth of Massachusetts was utilized. By law, this yearly Census of Manufactures includes the following items: number of establishments; capital invested; value of stock and materials used; amount of wages paid during the year; average number of wage earners employed; and value of products for each municipality. Of these, the number of establishments, amount of capital invested, and average number of wage earners employed were found to be most pertinent and were therefore used.

None of these three criteria indicates clearly changes in the industrial location pattern. Increase in number of employees from year to year does not necessarily reflect any new development. Re-use of vacant facilities or additions may be responsible for this statistical change. Likewise, the total number of establishments may be affected by the utilization of old vacant factories rather than the construction of new factories in more favorable locations. Capital investment in these tabulations means the amount of capital used as a factor in production and distribution by manufacturers and includes such items as inventory, cash, accounts, and notes receivable. However, the obvious inadequacy of this category as a measure of new industrial location does not warrant its exclusion as an indicator of general industrial activity. Using these three categories in combination as a bench mark or basis for objective comparison, the more valid, if less accurate statistically, data available on industrial building permits were analyzed.

Building permit statistics offer the more reliable guide to new industrial location activity and have been utilized in this study to indicate direction and amount of new industrial construction and to serve as a basis for correlative analyses between new locations and influential location factors. Building permit information obtained from the Division of Statistics of the Department of Labor and Industries was augmented by material taken from the annual industrial development survey of the Associated Industries of Massachusetts. The Division of Statistics' monthly reports varied in minimum value of construction reported from $50,000 in 1946 to $100,000 in 1951 and was incomplete in coverage for 28 towns out of the 100 between the years 1946 - 1951 and 31 towns between the years 1946 - 1949. While unofficial, the A.I.M. Statistics are more

comprehensive, covering all values of construction and all but a very small percentage of the municipalities. Thus, the combination of the two sources provides a relatively accurate picture.

D. Limitations

Both the Census of Manufactures and the Building Permit data have limitations. By statute, certain industrially small municipalities (30 in this study) may not have manufacturing data published. This valid precaution to avoid disclosure dictated certain consolidations of data which might not otherwise have been made, but did not effectively alter the general result.

The building permit material might seem to be subject to suspicion by its very nature. However, experienced observers in this field feel that only a very small percentage of industrial building permits that are issued are not carried through to completion. The estimated cost of construction cannot be relied upon completely to give the dollar value of new construction, common practice being to underestimate, and yearly errors in the total for any one municipality may appear from the time lag due to varying lengths of the construction period. These are compensating discrepancies, however, and have little effect when using the data in a comparative analysis. A more serious limitation found in the building permit data was the incomplete identification of many of the projects and the lack of distinction between new construction and additions to existing facilities. The data were reliable in locating the units relative to a particular municipality, but in many cases names and addresses and types of construction information were obtainable only after extensive and time consuming checks had been made. This was done only when pertinent to the precise spotting and more intensive analysis which is found in Part II of this study.

Section 2. FINDINGS

A. General

During the six year period covered by this study, 1946 through 1951, the dollar value of industrial construction in the BMA, as reflected in building permit applications, was approximately $59,500,000. This total value resulted from 670 applications filed during this period. The following table shows the yearly totals for these two indicators:

Industrial Construction

1946-1951

	1946	1947	1948	1949	1950	1951	BMA TOTAL
Value (Millions $)	9	13	6	2	9	20.5	59.5
Number	113	189	64	48	119	136	670

The above table reveals that the large proportion of construction which occurred during the last two years of this period cannot be accurately correlated with the statistics which describe the general industrial pattern, primarily because the last available year of such data was 1950. The nature of these data, their unreliability due to time lag caused by the variable period between applications for permits and occupancy dates, limits their use also as an indicator of the time-relationship between new industrial construction and population increase. The relatively short period covered by this study is another limiting factor for this purpose. However, a meaningful relationship can be observed between new industrial construction and general population and industrial trends in respect to their distance, direction, and magnitude. The following presentation is

an attempt to describe, both verbally and graphically, this phase of Metropolitan Boston's development during the post-war years 1946 through 1951.

B. Relationships of Central Core to BMA

Table I, page 26 and Chart (a), page 19, reveal that the Central Core cities, while containing 53 percent of the capital investment in industrial activity in 1945 and 61 percent of the number of establishments, were receiving only 31 percent of the dollar volume invested in new construction and were experiencing but 41 percent of the construction activity as reflected by the number of new undertakings. Similarly, the proportional balance was reversing direction in respect to total population gained by the Core and the remaining area in the BMA, the Core's share being 35 percent and the rest of the BMA 65 percent. This compared to 45 percent and 55 percent of the absolute number in 1945 for the respective areas.

A comparison of figures shown in Table I and an observation of Chart (a), a graphic representation of these data, indicate the extent to which industrial decentralization occurred in the area lying beyond a 6 mile radius of Downtown Boston during the postwar years 1946 through 1951. While the industrial construction data are not representative unqualifiedly of new industrial location, they do indirectly reflect industrial decentralization trends during this period. The core recorded only 34 percent of the BMA permits valued above $250,000, and it can be assumed that a large majority of undertakings at a cost above this amount take place on new sites. The marked difference in the average cost per undertaking between the two areas also provides a measure of the decentralization process. The average cost for the BMA as a whole was $88,000, that for the Central Core

was $70,000, and for the remaining area the considerably higher amount of $105,000. Increases in general industrial activity, as measured by total capital invested, number of employees, and number of establishments, substantiates the conclusion that a sizeable amount of decentralization occurred.

The shares of the two areas (Core and rest of BMA) of the total BMA gain in both population and new industrial construction were nearly the same. As previously noted, the short time-period of the study and the time lag inherent in the data do not permit a conclusion as to which of the two, population or new industrial construction, precedes the other or is the more determinant as a factor in the development process which results in the normal state of interdependence. However, it is evident that, when analyzed on a base of the broad and large scale division of the BMA, population and industrial patterns are coincident both as to extent and geographic location.

C. Relationships Between Rings

Comparative data of the two Rings which comprise the BMA excluding the Central Core, termed 2 and 3 (Intermediate and Outer) for convenience in geographic descriptions, give a more definitive picture of distance from the center of the metropolitan area as it relates to New Industrial Construction, Population, and Existing Industrial Activity during the study period. In general, the Intermediate Ring had the larger share of the population existing outside the Core in 1945 and was the area where the greater amount of the BMA gain occurred between the years 1945 through 1950. On the other hand, the Outer Ring experienced the greater percent gain during this period.

In 1945 Ring 2 had a little more than four times the population and considerably more than four times the industrial activity of Ring 3.

During the six year period beginning in 1945, Ring 3 experienced one half as much new industrial construction measured in terms of dollar value, a little less than one sixth the number of construction undertakings, and almost one half the number costing more than $250,000. See Table 2[4], page 27 and Charts (b) and (c), pages 21 and 22 . The fact that the Outer Ring received only 9 percent of the total number of industrial construction jobs and 20 percent of those costing more than $250,000 indicates a pattern of larger plants in this area. This fact is reinforced by comparing the average cost per construction. Ring 2 and the Central Core averaged almost exactly the same, $70,000, while the Outer Ring average was $267,000 or nearly four times as much.

The entire Boston Metropolitan Area underwent a net change in number of establishments of zero during the years 1945-1950. The Central Core had a loss of 5 percent. Ring 2, which shared a 50 percent portion of the total metropolitan new industrial construction during the 1946-1951 study period, a considerable part of which was undertaken by new establishments on new sites, experienced during 1945-1950 a net increase of but 5 percent, thus indicating a condition of relative instability in this area during the post-war adjustment period. Ring 3, which had only 8 percent of the industrial activity in 1945, had a 26 percent share of the BMA new construction value, and its 9 percent share of the BMA number of construction undertakings is reflected in the 1950 Census of Manufactures data which reveals a 15 percent gain in total number of industrial establishments.

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4) Sources of data are the same as Table I for all tables and charts in this part of the study.

Shares of both 1945 BMA population and amount of new industrial construction in Ring 2 paralleled each other. Its relationship with the Central Core in these two categories remained roughly the same. On the other hand, Ring 3, which had only 10 percent of the BMA population in 1945, had four times the percent of population gain as either of the other two divisions and 26 percent of the total BMA dollar investment in new construction. While this Outer Ring was experiencing a rate of population growth of nearly 15 percent, Ring 2 and the Central Core were gaining at a rate less than 5 percent.

D. Relationships Among Groups

An analysis of Group relationships not only aids in revealing to a more precise degree where the greatest amount of new industrial construction occurred but shows also the important relationships between this increase in industrial activity and population and existing industry. See Table 3, page 28 and Chart (d), page 23 .

The Group having the largest dollar volume of industrial construction was the Southwest in the Outer Ring. This Group, led by the Framingham industrial concentration, had 20 percent of the Metropolitan total as compared to 32 percent for the Central Core. This Group was followed by the Northwest in Ring 2 with 16 percent and four of the five remaining Groups in this ring. In the number of undertakings the Southwest-Ring 3 Group ranked only sixth, being far surpassed by the three Northern Groups in the Intermediate Ring. The leading Group in number of undertakings was Northwest-Ring 2 which also was the leader in number costing more than $250,000. The South and Southeast Groups were lowest in their respective rings for all measurements of new industrial construction. The lowest Group of all twelve was the Southeast-Ring 3.

The Southwest Group in Ring 3, leader in total industrial construction investment of all Groups in the area excluding the Central Core, had the highest population of those in its ring in 1945 but did not exceed any Group in Ring 2 in this category. It did have, however, the third highest percent gain and the second highest absolute number gain of all Groups. It was exceeded in absolute population gain for the 1945-1950 period only by the Southeast-Ring 2 Group, a Group which only ranked fifth in dollar volume of new construction and seventh in number of new construction projects.

The Group which had the highest amount of population in 1945, Northeast-Ring 2, also enjoyed the greatest measure of industrial activity that year exceeding any other Group by two times in the amount of capital invested, number of employees, and number of establishments. See Table 5, page 30 . This Group, while not being first in any, was second or third in all of the categories employed in this study to measure new industrial construction during the following six years.

In summary, Groups in Ring 2, in general, had during this study period the greater amounts of population, existing industrial activity, and new industrial construction. The outstanding exception to the latter was Southwest-Ring 3, a Group which, in relation to its Ring, had the greatest absolute number of inhabitants in 1945 and the largest amount of industrial activity. Two groups in the Outer Ring, North and Southeast, had the highest rates of population gain in the entire BMA but the lowest amounts of existing industrial activity and new construction.

E. Relationships Among Sectors

Sector relationships most clearly reveal the directions, geographically, in which industrial construction took place during the 1946-1951

period and, to a lesser degree, the correlation, if any, between this new activity and existing population and industry. Table 4, page and Chart (e), page 24 , show these Sector relationships and also reveal that all three measures for 1945 industry are relatively the same.

The Southwest Sector was highest in value of new industrial construction for the study period and the South and Southeast Sectors were the lowest. However, the Northwest Sector, while ranking second in value of new construction, was first in number of projects undertaken, thereby placing it in a position of equal importance with that of the Southwest with respect to industrial construction. These two Sectors varied considerably in their relationships to existing population and industry, the Northwest ranking high in both and the Southwest low in each. See Chart (f), page 25 . Both of these sectors were relatively high in percent gain and absolute gain in population. Contradicting the apparent correlation between population gain and amount of new construction, as revealed by a comparison of the two Sectors, are the data showing a high rank in population gain and absolute number for the Southeast Sector and at the same time the lowest rank in new industrial construction.

The broader geographic divisions, Quadrants, which result from the combination of two Sectors in each of the three basic compass directions inherent in the total Boston Metropolitan Area physical pattern; North, West, and South, provide a simpler framework for a comparative analysis of the factors considered in this study.

The Northern Quadrant (Northeast and North Sectors) had the largest share of population in 1945 and smallest amount of population gain in percent and absolute number during the following five years and, while being the most active Quadrant industrially in 1945, was only second of the three in attracting new industrial construction during the 1946-1951

period. It was strong in relation to the number of construction projects undertaken and relatively weak in the number of those which cost more than $250,000, indicating a considerable amount of low cost additions or alterations to existing industrial facilities in this old area.

In respect to population, the Western Quadrant (Northwest and Southwest Sectors) was the opposite of the Northern. It had a relatively small amount of the existing population and experienced the largest amount of absolute population gain and percent gain. As an area of general industrial activity in 1945, it was the weakest of the three. As a Quadrant it ranked first in all three measures of new industrial construction activity: percent of BMA dollar value, percent of BMA number, and percent of BMA number costing more than $250,000. In two categories, value of new construction and number over $250,000, this Quadrant lead and equalled respectively the Central Core, which exceeded it by nearly four times in amount of population and industry in 1945.

The Southern Quadrant (Southeast and South Sectors) had a 1945 population level nearly equalling that of the Western Quadrant. In industrial activity for that year it was also nearly the same. In contrast to this relationship, the area to the South received approximately 6 percent of the total BMA new industrial construction as measured by dollar volume of building permits and the Western area gained nearly seven times as much during the post-war period, 1946 through 1951.

F. Summary of Findings

The findings of Part I of this study are essentially of two kinds. The first is quantitative in nature and more objective, involving the location and magnitude of postwar industrial construction. The other describes the relationships between the pattern this construction took

and the patterns of population and general industrial activity as it existed at the beginning of the study period. Subject to the limitations described in Section 1, the following are some of the significant findings of this part of the analysis.

(1) Distance, Direction, and Magnitude

a. In relation to the Central Core, the remainder of the BMA had the larger amount of new industrial construction activity. The relationship was 69 percent to 31 percent for the Core. There was roughly the same relationship for the number of projects costing more than $250,000.

b. Of this greater share of the BMA total, nearly two thirds occurred on sites within the area (Intermediate Ring) lying at a distance of approximately 6 to 15 miles from the metropolitan center (Boston Common).

c. All construction projects costing more than $1,000,000 took place outside a 6 mile radius of the metropolitan center. Of the 8 which were reported, 6 occurred in the Intermediate Ring.

d. Forty six percent of the total number of construction projects costing more than $250,000 took place in the Intermediate Ring.

e. The Intermediate Ring reported 50 percent of total number of projects (670). The Core and the Outer Ring reported 41 percent and 9 percent respectively.

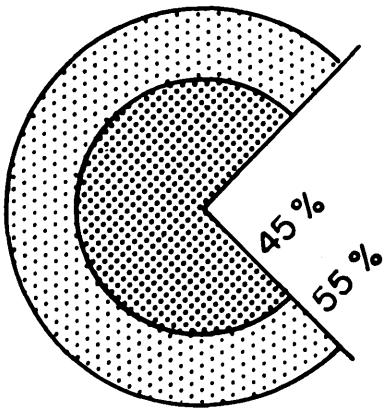
f. The most dominant direction in terms of new industrial construction was the west (Northwest and Southwest Sectors), with the Southwest Sector being the stronger of the two in dollar value but slightly lower in number of projects.

(2) Relationships Between New Industrial Construction and Population and Existing Industry

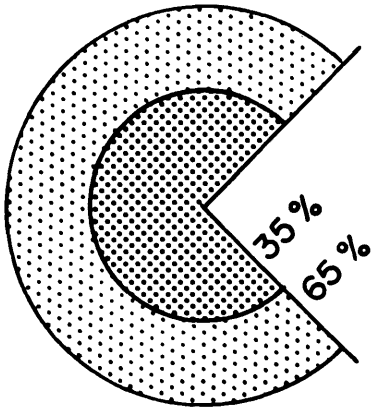
a. In nearly all geographic comparisons; Central Core to rest of BMA, Ring to Ring, Sector to Sector, and Group to Group, the best correlation of new industrial construction activity was found to be with population gain rather than existing population or existing industry. The outstanding exception was the Southeast Group, in the Intermediate Ring, which had the highest population gain and a very small amount of new construction. The smallest subdivision of areas (Groups) provided the best correlation in most instances.

b. There was a close relationship between existing population (1945) and new construction only in the Intermediate Ring. The Core received proportionately less and the Outer Ring proportionately more in dollar value reported.

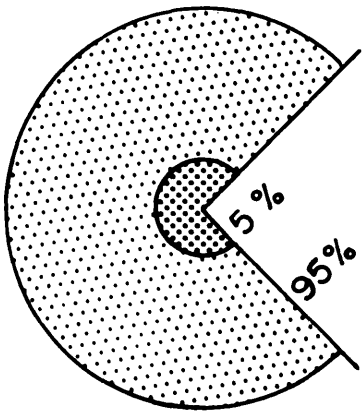
c. There was the least relationship when comparing new construction and existing industry .



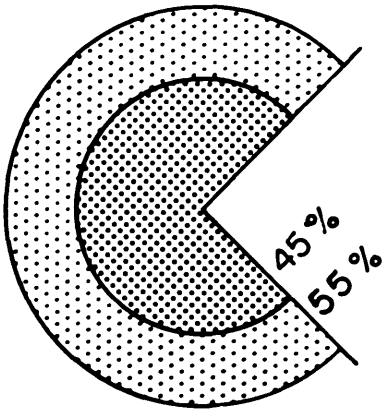
POPULATION - 1945



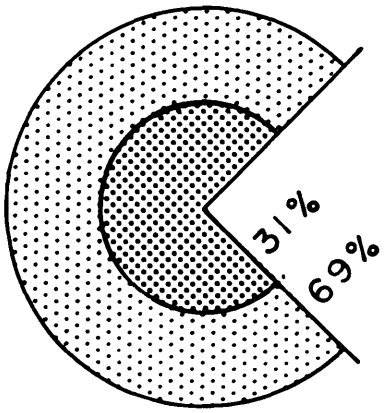
POP. GAIN, '45-'50



AREA



INDUST. EMPLOYMENT
1945



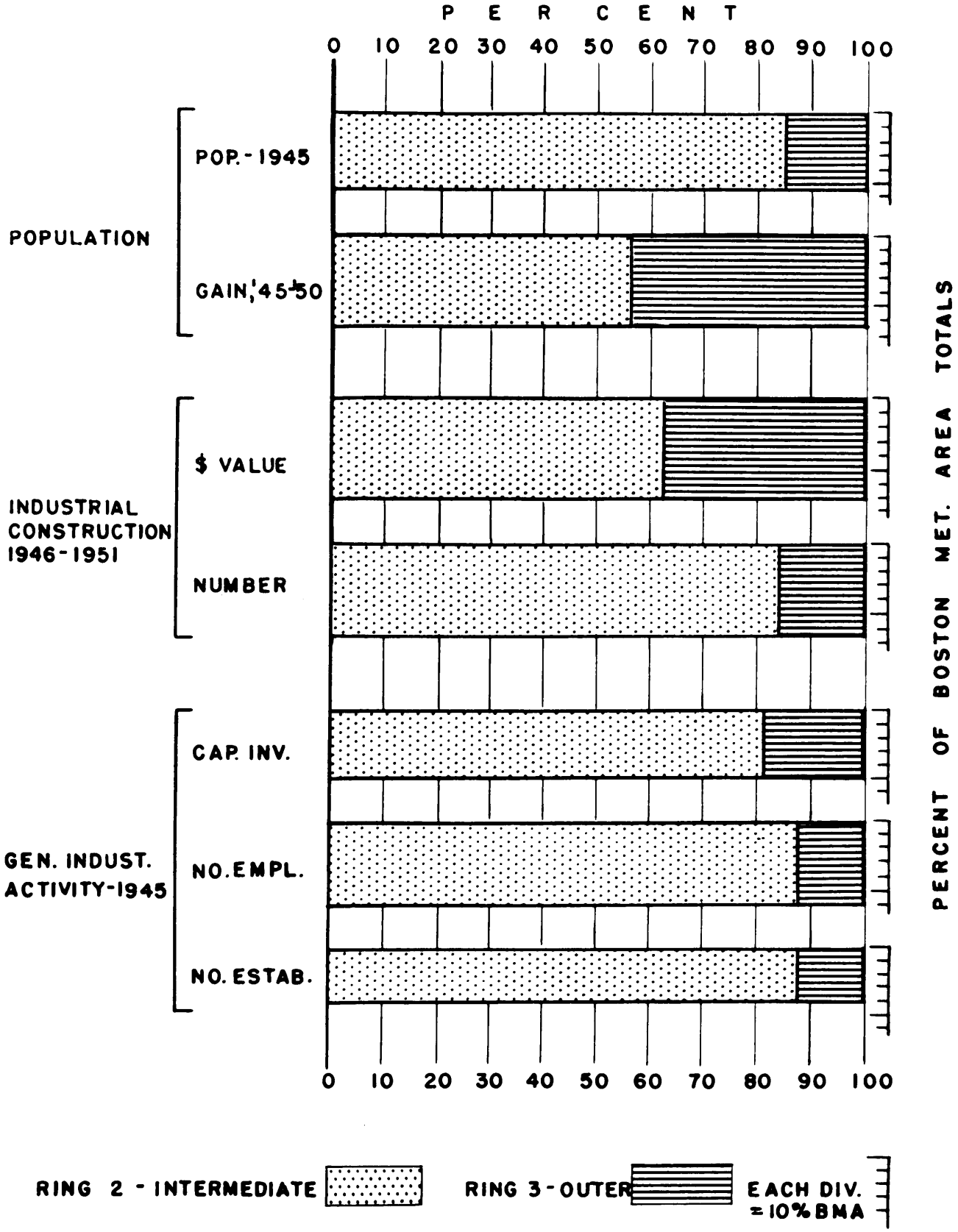
NEW INDUST. CONSTR.
1946 - 1951

CHAR

COMPARISON OF CENTRAL CORE
TO REST OF BOSTON METROPOLITAN AREA

PERCENT AREA, POP. AND INDUSTRY TO MET. TOTAL

a

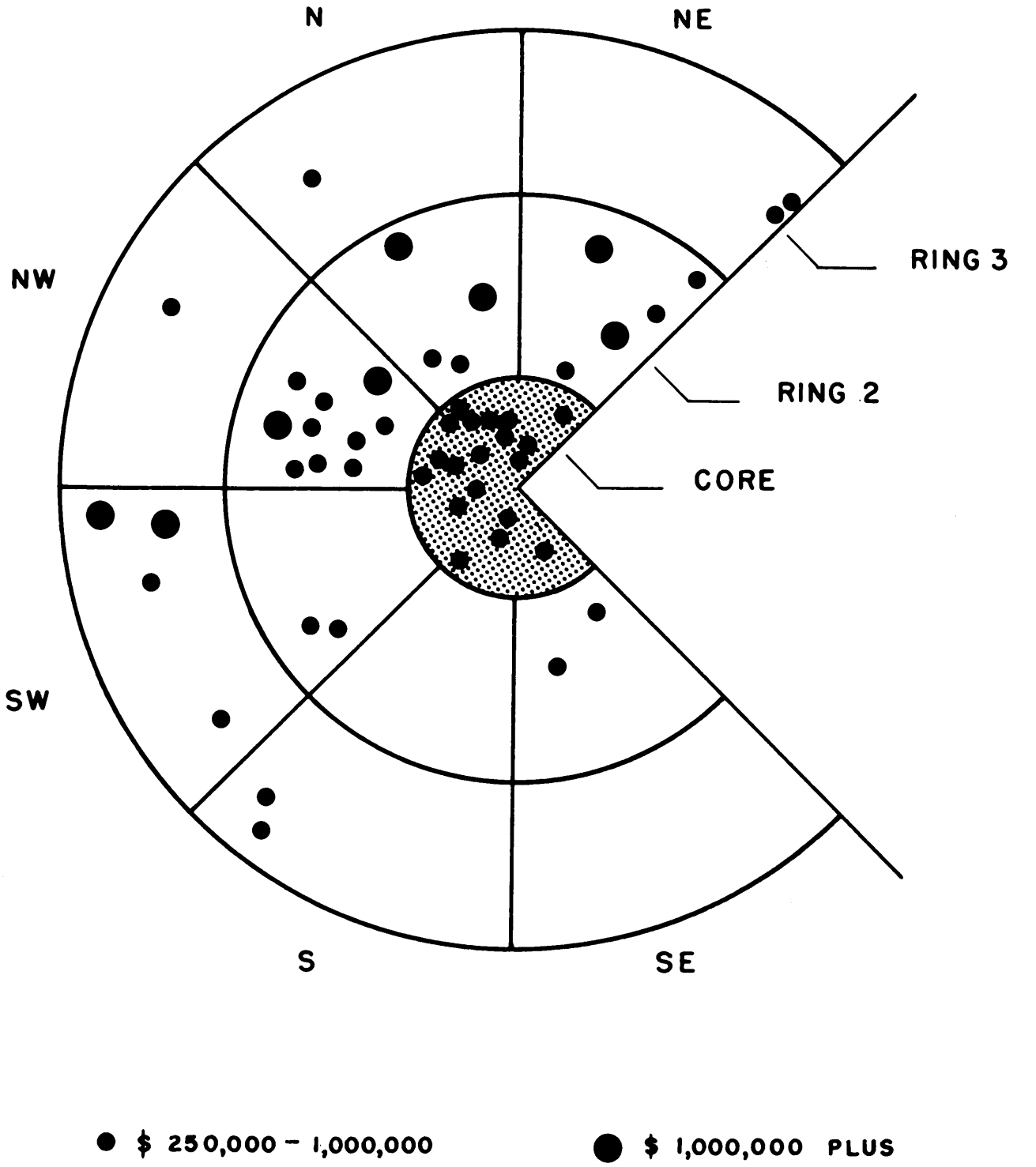


CHART

b

PERCENT OF POPULATION & INDUSTRY IN RINGS

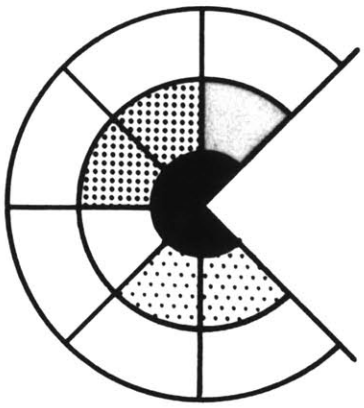
BMA EXCLUDING CENTRAL CORE



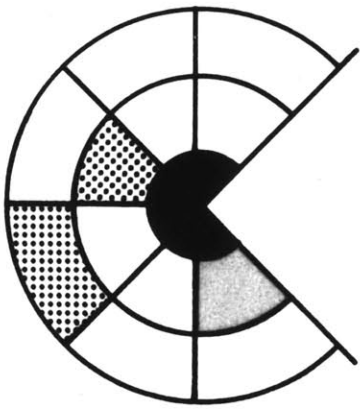
CHART

DIAGRAMMATIC LOCATION OF INDUSTRIAL CONSTRUCTION COSTING MORE THAN $ 250,000 - BMA , 1946 - 1951

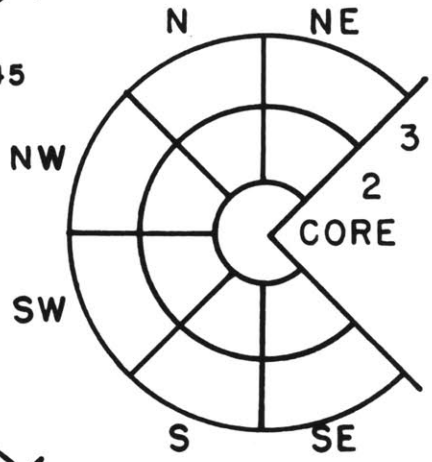
C

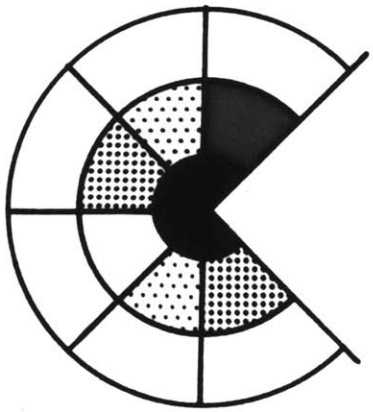


POPULATION, 1945

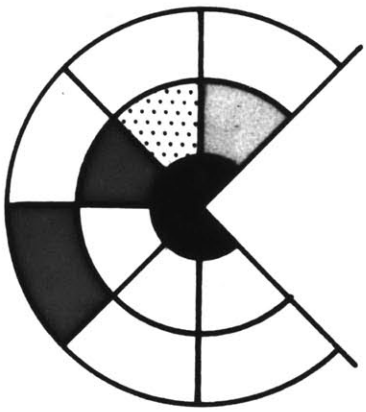


POP. GAIN, '40-'50

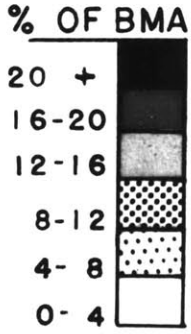




INDUST. EMPLOYMENT
1945-1950



NEW INDUST. CONST.
1946 - 1951



CHART

COMPARISON OF GROUPS BY %
POPULATION AND INDUSTRY

d

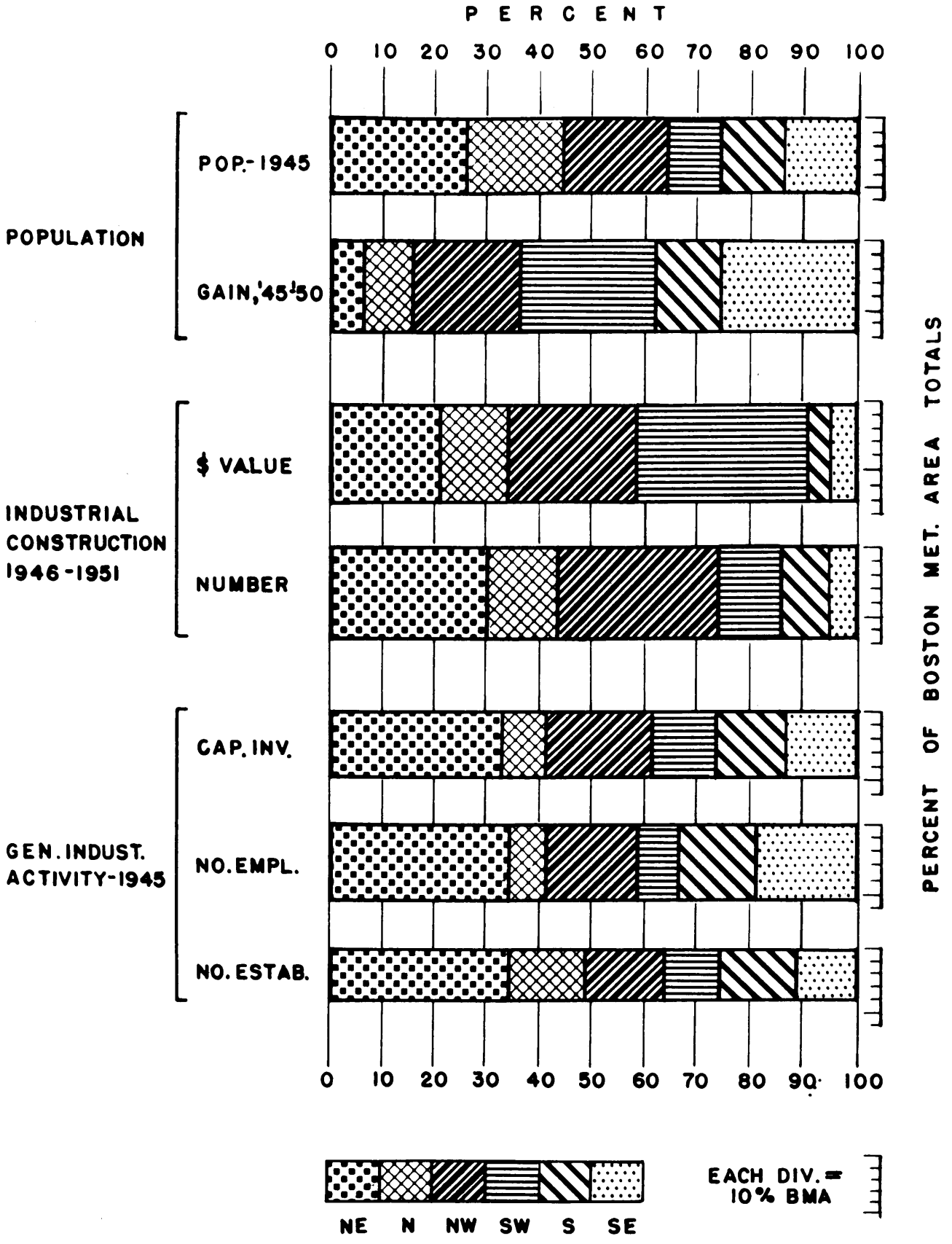
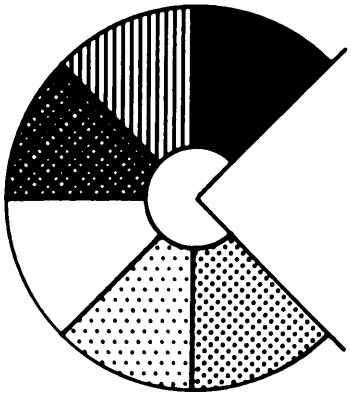
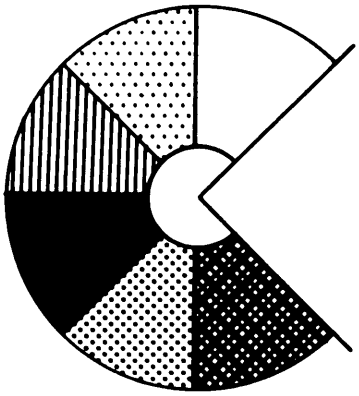


CHART e

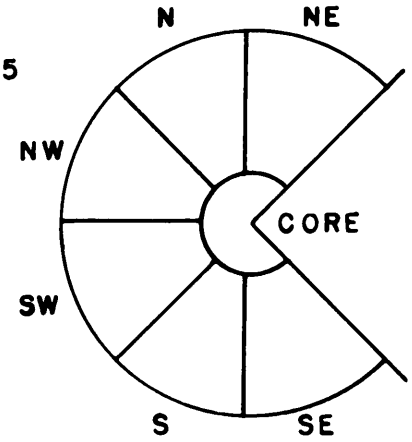
PERCENT OF POPULATION & INDUSTRY IN SECTORS OF BMA EXCLUDING CENTRAL CORE

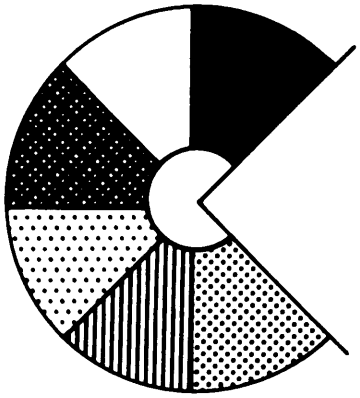


POPULATION - 1945

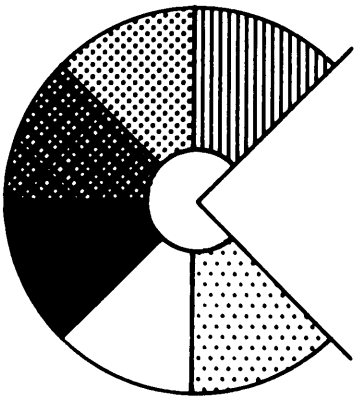


POP. GAIN '45-'50

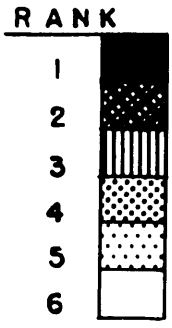




INDUST. EMPLOYMENT
1945



NEW INDUST. CONSTR.
1946 - 1951



CHART

COMPARISON OF SECTORS BY RANK

POPULATION AND INDUSTRY

f

TABLE I

RELATIONSHIP BETWEEN CENT. CORE AND REST OF BMA - Population, New Industrial Construction, and 1945 Industrial Activity

	CENT. CORE	2+3 (REST OF BMA)	TOTAL BMA
POPULATION[a]			
% of BMA 1945	45	55	100
% Gain, '45-'50	3	6	4
% of BMA Gain, '45-'50	35	65	100
INDUST. CONSTRUCTION-'46-'51[b]			
% of BMA Value	31	69	100
% of BMA Number	41	59	100
% of BMA Number over $250,000	34	66	100
Av. Cost per Job (Thous. $)	70	105	88
GEN. INDUSTRIAL ACTIVITY[c]			
Cap. Inv.-% of BMA,1945	53	47	100
Cap. Inv.-% Incr. '45-'50	37	45	41
No. Empl.,-% of BMA, 1945	45	55	100
No. Empl.,-% Incr.,'45-'50	-6	-16*	-11
No. Estab.-% of BMA, 1945	61	39	100
No. Estab.-% Incr.,'45-'50	-5	7	0

* This decrease in employment occurred in Ring 2 and principally in the the towns of Hingham, Quincy, and Lynn. These towns contributed 92% of this decrease which was primarily caused by post-war decline in ship-building and electronics.

SOURCES:

a. U.S. Census: Population, 1950 and Mass. Decennial Census of Population, 1945

b. Reports of Bldg. Permit applications compiled by Dept. of Labor and Industries - Div. of Statistics and Annual surveys of new industrial construction published in the magazine Industry by The Associated Industries of Mass.

c. Census of Manufactures; Mass. Dept. of Labor and Industries - Div. of Labor Statistics.

TABLE 2

RELATIONSHIP BETWEEN CENTRAL CORE, RING 2 AND RING 3 - Population, New Industrial Construction, and 1945 Industrial Activity

	CENT. CORE	RING 2	RING 3	TOTAL BMA
Population				
% of BMA, 1945	45	45	10	100
% Gain, '45-'50	3.3	3.3	13.1	4.2
% of BMA Gain, '45-'50	35	37	28	100
INDUST. CONSTRUCTION, '46-'51				
% of BMA Value	31	43	26	100
% of BMA Number	41	50	9	100
% of BMA Number over $250,000	34	46	20	100
Av. Cost per Job (Thous. $)	70	73	267	88
GEN. INDUST. ACTIVITY				
Cap. Inv.-% of BMA, 1945	53	38	9	100
Cap. Inv.-% Incr., '45-'50	37	46	39	41
No. Empl.-% of BMA, 1945	45	48	7	100
No. Empl.-% Incr.,'45-'50	-6	-20	11	-11
No. Estab.-% of BMA, 1945	61	34	5	100
No. Estab.-% Incr., '45-'50	-5	5	15	0

TABLE 3

RELATIONSHIP BETWEEN CENTRAL CORE AND GROUPS
Population, New Industrial Construction, and 1945 Industrial Activity

	POPULATION 1945-1950			INDUST. CONSTRUCTION 1946-1951			GEN. INDUST. ACTIVITY 1945		
	% of BMA 1945	% Gain '45-'50	% of BMA Gain '45-'50	% of BMA $ Value	% of BMA number	% of BMA number over $250,000	cap. inv. % of BMA	no. empl. % of BMA	no. estab. % of BMA
CENTRAL CORE	45	3.3	35	32	40	34	53	45	61
RING 2 (INTERMEDIATE)									
NE	12.1	.7	2.0	12.1	15.7	10	14.5	17.7	12.2
N	9.1	1.2	2.4	7.7	7.8	8	4.2	4.3	5.9
NW	9.1	4.2	9.6	16.1	17.4	20	7.6	8.0	5.2
SW	3.1	11.1	7.1	2.2	4.4	4	2.0	1.7	1.5
S	5.2	3.0	3.6	0.9	2.9	0	4.9	6.2	5.7
SE	6.4	7.0	12.3	3.0	2.8	4	4.8	10.1	3.5
TOTAL	45.0	3.3	37.0	42.0	51.0	46	38.0	48.0	34.0
RING 3 (OUTER)									
NE	2.1	6.0	2.6	2.3	1.4	4	1.2	1.0	1.2
N	.5	30.0	3.2	.6	.2	2	.02	.04	.1
NW	1.6	11.3	3.9	1.1	1.0	2	1.3	.5	.4
SW	3.1	14.8	9.8	20.1	3.5	8	3.6	3.1	2.1
S	1.8	10.0	3.9	1.8	2.5	4	1.7	1.3	1.0
SE	.9	23.6	4.6	.1	.4	0	1.2	1.1	.2
TOTAL	10.0	13.1	28.0	26.0	9.0	20	9.0	7.0	5.0
BOSTON MET. AREA	100	4.2	100	100	100	100	100	100	100

TABLE 4

RELATIONSHIP BETWEEN SECTORS AND CENTRAL CORE - Population, New Indust. Construction, and 1945 Indust. Activity

	POPULATION 1945-1950			INDUST. CONSTRUCTION 1946-1951			GEN. INDUST. ACTIVITY 1945		
	% of BMA 1945	% Gain '45-'50	% of BMA Gain '45-'50	% of BMA $ Value	% of BMA number	% of BMA number over $250,000	cap. inv. % of BMA	no. empl. % of BMA	no. estab. % of BMA
CENTRAL CORE	45	3.3	35	31	41	34	53	45	61
SECTORS									
NE	14.2	1.4	4.6	14.3	17.2	14	15.7	18.7	13.4
N	9.6	2.6	5.6	8.3	8.0	10	4.2	4.3	6.0
NW	10.7	5.2	13.5	17.1	18.4	22	8.9	8.5	5.6
SW	6.2	12.8	16.9	22.2	7.9	12	5.6	4.8	3.6
S	7.0	4.6	7.5	2.7	5.4	4	6.6	7.5	6.7
SE	7.3	8.9	16.9	3.1	3.2	4	6.0	11.2	3.7
BOSTON MET. AREA	100	4.2	100	100	100	100	100	100	100

TABLE 5

COMPARISON OF GROUPS AND SECTORS BY RANK - Population, New Industrial Construction, and 1945 Industrial Activity

	POPULATION 1945-1950			INDUST. CONSTRUCTION 1946-1951			GEN. INDUST. ACTIVITY 1945		
	% of BMA 1945	% Gain '45-'50	% of BMA Gain '45-'50	% of BMA $ value	% of BMA number	% of BMA number over $250,000	cap. inv. % of BMA	no. empl. % of BMA	no. estab. % of BMA
RING 2 (Intermediate)				GROUPS (1 to 12)					
NE	1	12	12	3	2	2	1	1	1
N	3	11	11	4	3	3	5	5	2
NW	2	9	3	2	1	1	2	3	4
SW	6	5	4	6	4	5	7	7	7
S	7	10	8	10	6	12	3	4	3
SE	4	7	1	5	7	5	4	2	5
RING 3 (Outer)									
NE	8	8	10	7	9	5	11	10	8
N	12	1	9	11	12	9	12	12	12
NW	10	4	7	9	10	9	9	11	10
SW	6	3	2	1	5	3	6	6	6
S	9	6	6	8	8	5	8	8	9
SE	11	2	5	12	11	12	10	9	11
				SECTORS (1 to 6)					
NE	1	6	6	3	2	2	1	1	1
N	3	5	5	4	3	4	6	6	3
NW	2	3	3	2	1	1	2	3	4
SW	6	1	1	1	4	3	5	5	6
S	5	4	4	6	5	5	3	4	2
SE	4	2	2	5	6	5	4	2	5

PART II

An Analysis of Location Factors

OBJECTIVES

The second part of this study has as its basis a more detailed analysis and observation of 29 construction projects which were reported as having cost more than $250,000 and which were proposed for location on new sites during the 1946-1951 study period. Of the 50 over $250,000 which were found in Part I, 29 remained after eliminating those which were either on old sites or were found to be more commercial in character than industrial. These 29 comprised 4 percent of the total number reported and 30 percent of the total dollar value in new industrial construction.

The objectives of this more detailed study were 1) to determine the relationship between certain characteristics of the industries, which were felt to be factors in determining the industrial location pattern, and the actual pattern which evolved and 2) to determine or test the effect, on the actual pattern that developed, of certain variable characteristics common to any general area, characteristics which it was felt were influential in broader area decisions rather than in more precise site selections.

The Industry factors considered were:

a. Level of building investment-dollar value

b. Wage level of the industry

c. Type of product

d. Space requirements per employee

e. Intensity of land use

The Location Area factors considered were:

a. Population

b. Tax rate

c. Existing industry

It was recognized at the outset that both the complexity of the industrial location process and the scope of the study area would effectively prevent the attainment of valid answers in respect to either the degree of importance of these factors to industrial location in general or their relative significance in the locational selections which were analyzed in this part of the study. The primary objective was, therefore, to analyze the data which could be obtained without intensive field survey in such a manner that a fairly clear picture would develop as to the extent the six year location pattern could be correlated with the pattern which would result if these factors exerted their generally accepted, or assumed, influence. Throughout this analysis it was recognized that a factor, or factors, not considered here could have been most decisive in determining any one or more of the industrial locations observed.

Section 1. METHOD

A. General

By means of spot maps and graphs the individual plant locations were analyzed in relation to the above enumerated factors. In the analysis of the industry characteristics, the "common denominator" was distance from the metropolitan center. The general location characteristics were analyzed in relation to the degree of their prevalence in those areas which were selected for locating plants and the frequency of these relationships.

B. Sources of Data

As in Part I, building permit data, as reported by the Division of Statistics of the Massachusetts Department of Labor and Industries, was augmented by the yearly surveys of the Associated Industries of Massachusetts. These sources provided nearly all the information in respect to name of concern, municipality location, value of construction, and in some instances type of product.

Detailed information regarding wage levels, number of employees, amount of building area, and ground coverage was obtained from numerous sources and by various methods. Wage levels, in most cases, were estimated on the basis of type of product and its respective 1951 hourly average as reported by the Massachusetts Department of Labor and Industries. Data on number of employees were obtained from articles describing new plants published in local periodicals[5] and from field interviews with approximately 30 percent of the concerns. Building area was obtained mainly from the same sources. Where either building area or site size was not available from these sources, estimates were made based on personnal observation at the sites.

C. Limitations

The limitations inherent in building permit data are, of course, applicable to this part of the study also but to a lesser degree because many of the facts were checked in the field. Such data as wage levels, which could not be obtained directly, are subject to errors in the processes by which they were interpolated or estimated. These limitations, when they applied to specific items are more fully described in the following section.

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5) Industry, monthly publication of the Associated Industries of Massachusetts and The New England Newsletter issued monthly by the New England Council.

In general, the accuracy requirements of this comparative analysis are not so demanding that limitations of the magnitude found in these data would effectively alter the results.

Section 2. FINDINGS

A. General

Map 2, page 43, shows the location of 29 industrial buildings erected on new sites during the years 1946-1951. The plants are spotted according to their reported building permit valuation and reveal their relationships to distance from the metropolitan center and proximity to major highways.

In general, they were fairly well dispersed throughout the Northern half of the BMA. In the area outside the Central Core the Newton Industrial Center, a private development, is the only sizeable concentration. In terms of size of investment the large projects tended to increase with distance from the metropolitan center. All 7 of those reported as costing more than $1,000,000 were located outside a radius of 7 miles from the center. The opposite relationship is apparent in respect to number, as the following table indicates.

Miles From Met. Center	Number	No. Over $1,000,000
0 - 5	10	0
5 -10	10	1
10 -15	4	1
15 -20	5	3

The map locations emphasize the dominant Westward trend (half of those outside the Core were in this direction) and the relative lack of development in the Southern half of the BMA. All but one of the sites

were in close proximity to a major highway, and 9 were located within 2 miles of the circumferential highway, Route 128. Eight were outside Route 128, 4 of those being more than 7 miles from it.

B. Wage Level Relationships

Wage levels could not be obtained directly from any source. However, average hourly wage levels for production workers could be and were estimated for 24 of the projects by placing them in categories for which reports were available on employment and earnings from the Massachusetts Department of Labor and Industries.[6] The report of October, 1951 gave the best division of industries by type of product, a factor which was available in most cases. Some error is likely in the categorizing due both to the very general nature of the State's classifications and the inability to determine accurately which category the types of products of the various plants might be in.

Based on these classifications, three hourly wage levels were chosen: High, Medium, and Low. They include the following rates:

High - $1.75 to $2.00

Medium - $1.50 to $1.74

Low - $1.20 to $1.49

Using these three general levels, the relationships were observed between them and distance from the metropolitan center and proximity to the metropolitan center and proximity to the Metropolitan Transit Authority service area. See Map 3, page 44.

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6) Mfg. Survey No. 10, Employment and Earnings of Production Workers in Manufacturing, October, 1951; Division of Statistics - Mass. Dept. of Labor and Industries.

High wage level concerns were found to be, in general, in non-central locations. Only one (printing) in this category was located within a 5 mile radius of the center. All those in the low classification, with the exception of one, were found to be on sites within 10 miles of the metropolitan center.

The line on Map 3 designating the limits of the Metropolitan Transit Authority service area roughly bounds those areas from which a person can reach one of its forms of public transportation without walking more than 15 minutes. The relationship analyzed here is based on the hypotheses that low-wage industries would tend to locate within or near this area and that those industries which were not within the service area would probably be high-wage.

It is apparent, from this admittedly limited test, that both are generally valid. Of the 9 within the service area, 6 were in the low classification, 2 in the medium, and 1 in the high. Fifteen of the 24 were located outside the area. Three of these were high, 6 were medium, and 6 were low. Of the latter, 2 were within a mile of the area and two were located near or in relatively large population and industrial concentrations.

C. Type of Product Relationship

For purposes of this analysis the 25 manufacturing concerns were divided into two major classifications: durable goods producers and nondurable goods producers. The following tables show the various number of concerns in each of these classifications which built new plants during the six year study period and their location with respect to distance from the metropolitan center.

DURABLE

Product	No. Plants	Av. Distance (Miles)
Electrical (commun.)	4	13
Electrical (mchy.)	2	10
Trans. Equip.	1	18
Spec. Indust. Mchy.	3	10
Instruments & suppl.	2	10
Total:	12	Av: 12

NONDURABLE

Food & Bev.	6	6
Printing	1	3
Paper Prod.	3	3.5
Textile Prod.	1	7
Apparel	1	1
Chem. Prod.	1	4.5
Total:	13	Av: 5

Chart (g), page 39, shows clearly that nondurable producers tended to locate close to the metropolitan center, whereas producers of durable goods located in most instances on non-centralized sites. Thirteen nondurable producers located within a 10 mile radius of the center, and 9 of these within 5 miles. Of the 12 durable goods producers, all but 5 located outside a 10 mile radius from the metropolitan center.

D. Space Requirement Relationship

Two measures of production space required by industry were employed in this analysis. The first, floor area per worker, is shown, as it was correlated with distance from the metropolitan center, on Graph (a),

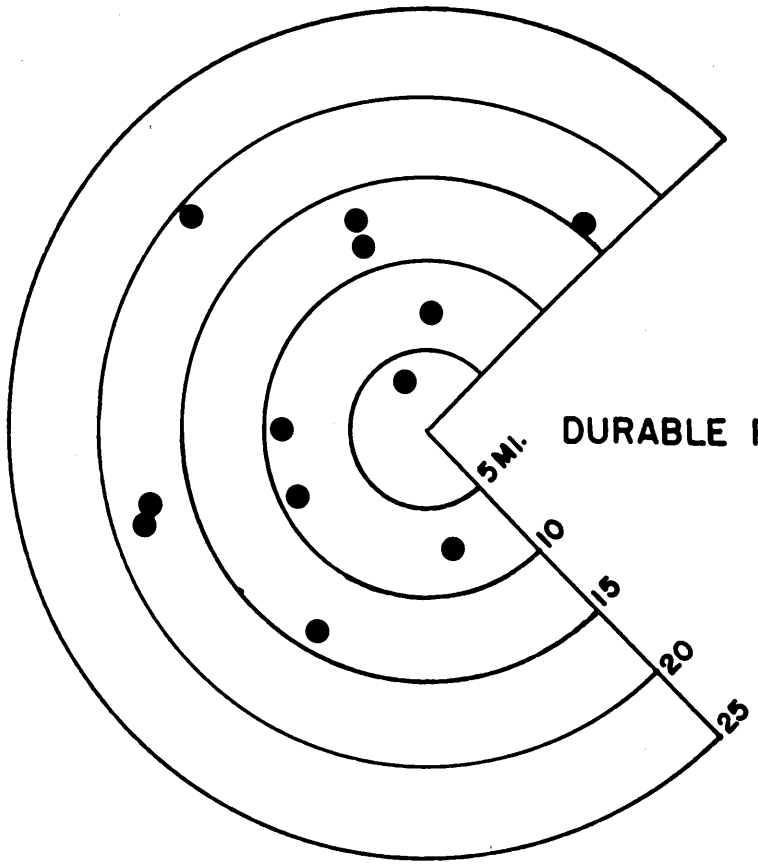
page 40. This graphical representation reveals those plants having higher amounts of floor area per worker had a slight tendency to be located at a greater distance from the center than those with lower ratios. Many exceptions are evident and the correlation is not very high. Because of the numerous factors (note warehouses on graph) and influences involved, it is difficult to imagine what could be considered even a fair correlation. Perhaps a much larger sample would show more clearly what the relationship is.

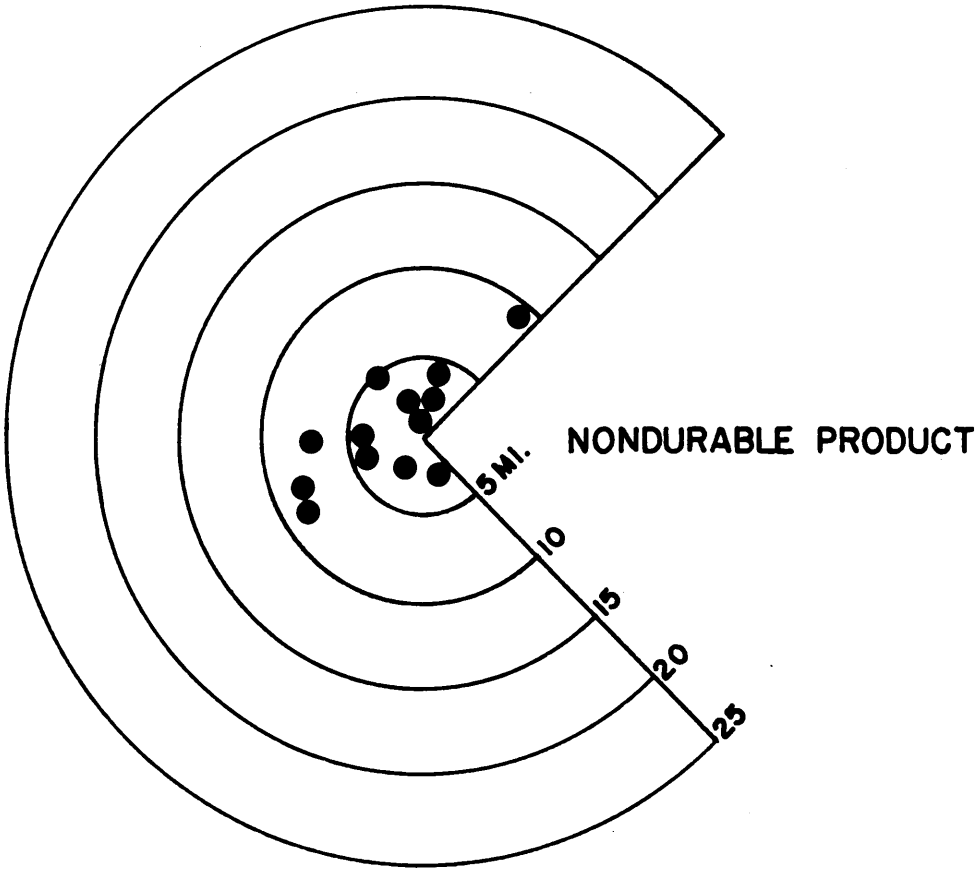
As an indicator of relative sizes of sites required by different industries, floor area ratio per worker does not make allowance for those industries which can operate economically in multi-story structures. Ground coverage does. Graph (b), page 41, shows the relationship between this measure and distance from the metropolitan center. Approximately the same degree of correlation was found in this comparison.

E. Intensity of Land Use Relationship

As shown on graph (c), page 42, the measure of intensity of land use, as provided by floor area ratios, was lowest at those locations which were at the greatest distance from the metropolitan center. A relatively high correlation existed between decreasing floor area ratio and increasing distance from center.

All plants which had a floor area ratio above .5 were within a five mile radius of the metropolitan center. The plant which had the highest floor area ratio (2.0) was located 4 miles from the center, and the plant which had the lowest was approximately 10 miles from the center.

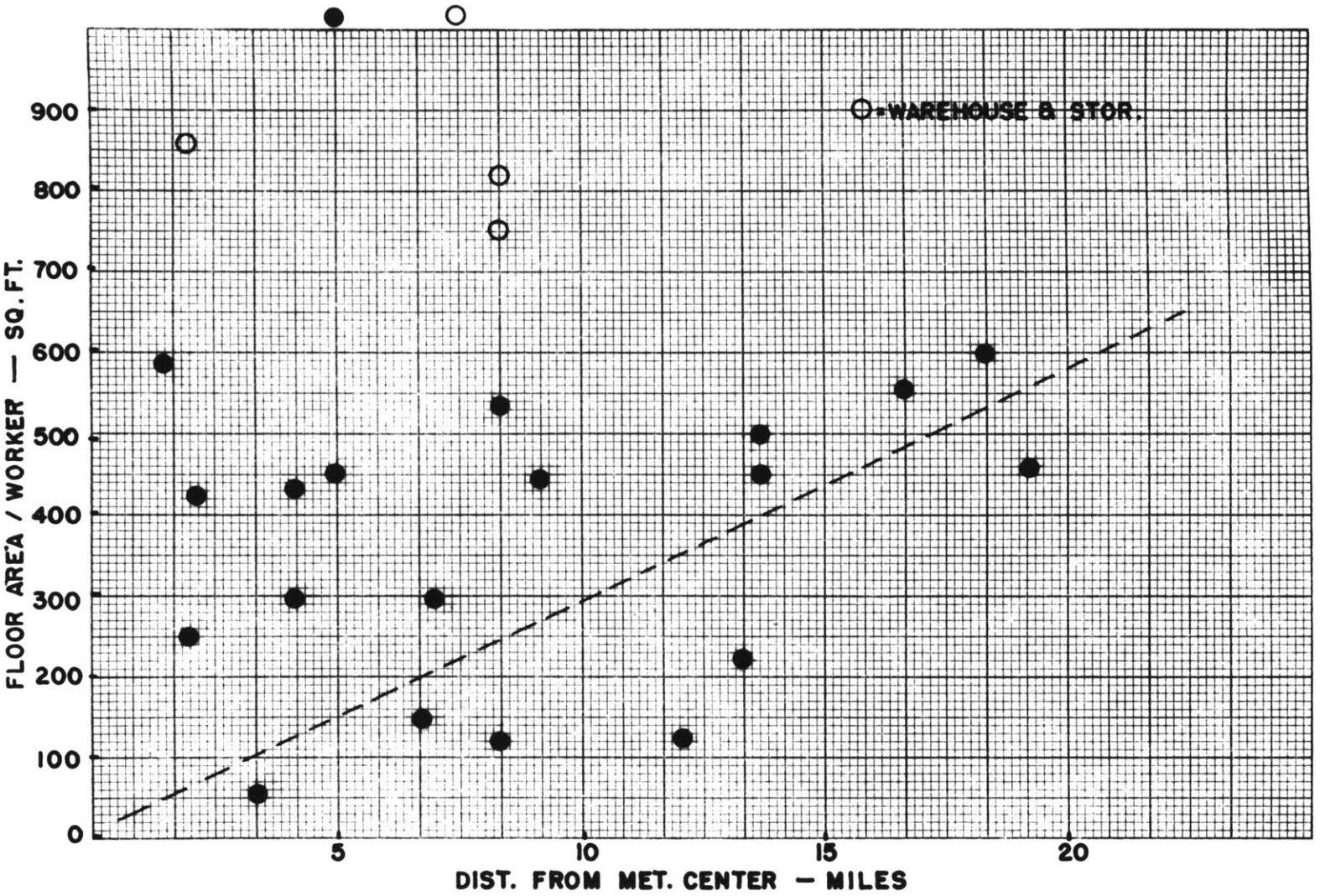




CHART

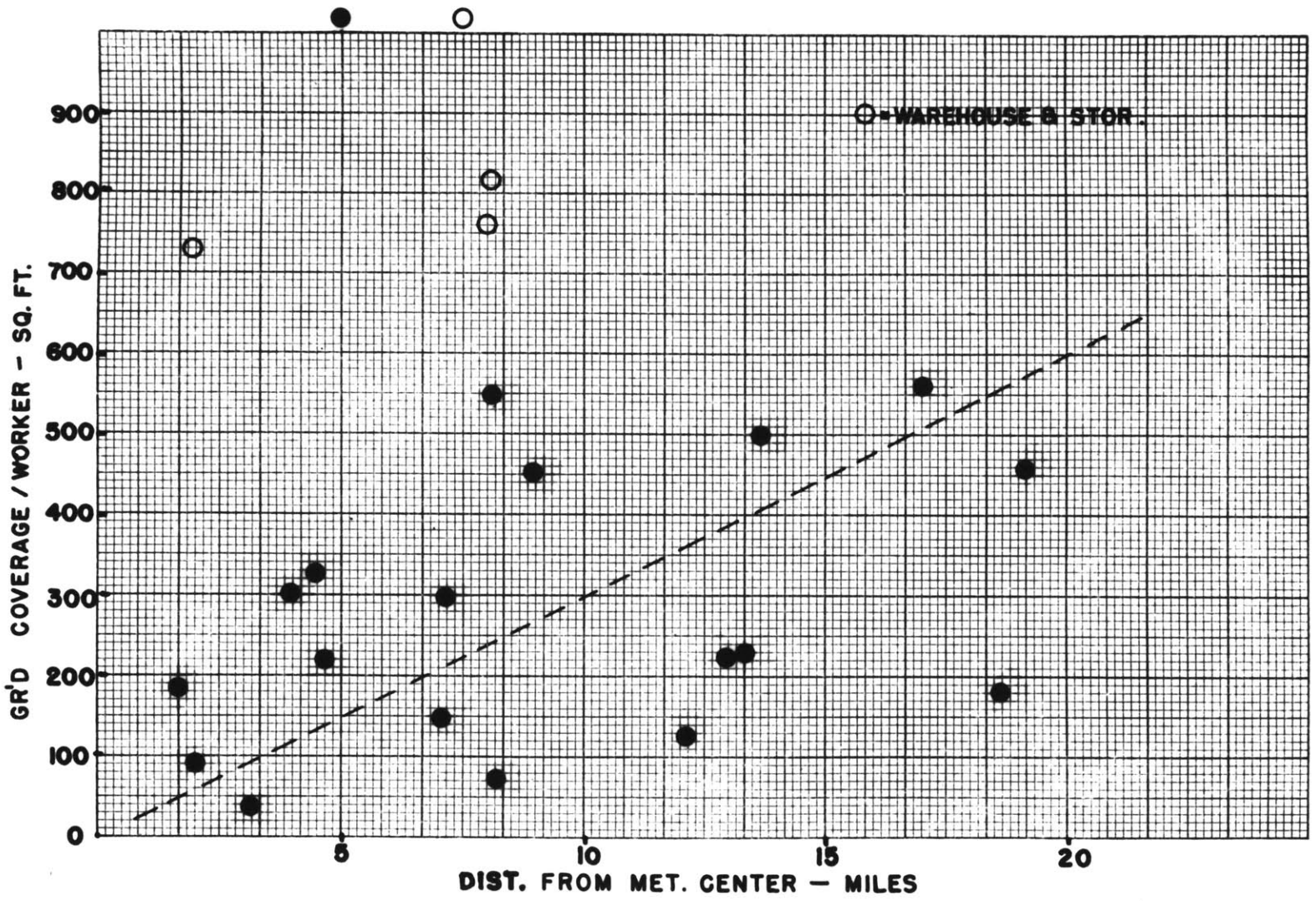
INDUST. PLANT LOCATIONS IN BMA, 1946 - 1951
DURABLE & NONDURABLE PROD.

g



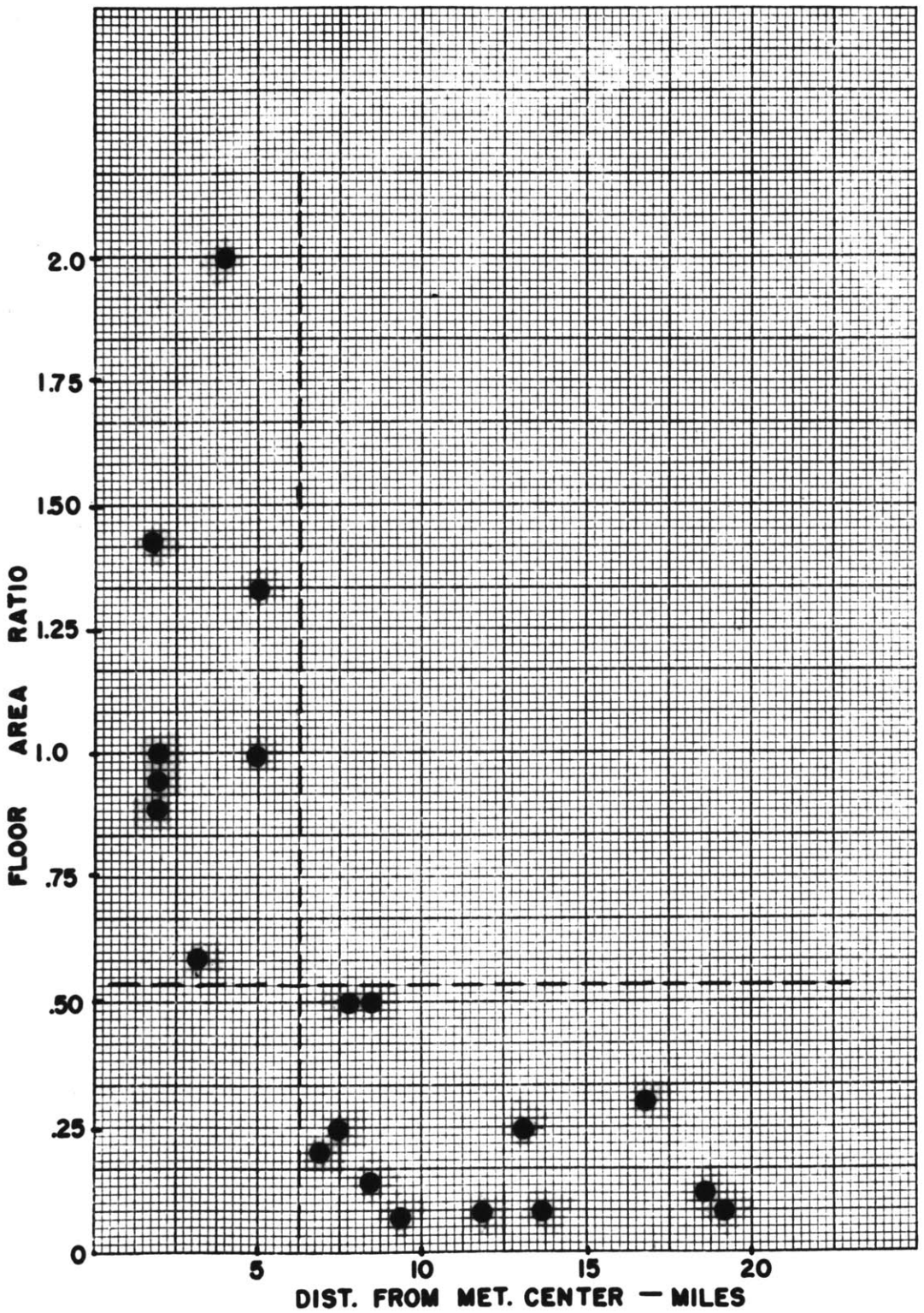
GRAPH — A

RELATIONSHIP BETWEEN FLOOR AREA / WORKER & PLANT LOCATION



GRAPH - B

RELATIONSHIP BETWEEN GR'D COVERAGE / WORKER & PLANT LOCATION



GRAPH — C

RELATIONSHIP BETWEEN FLOOR AREA RATIO & PLANT LOCATION

C

MAP

VALUE OF CONSTR. RELATED TO

PLANT LOCATIONS

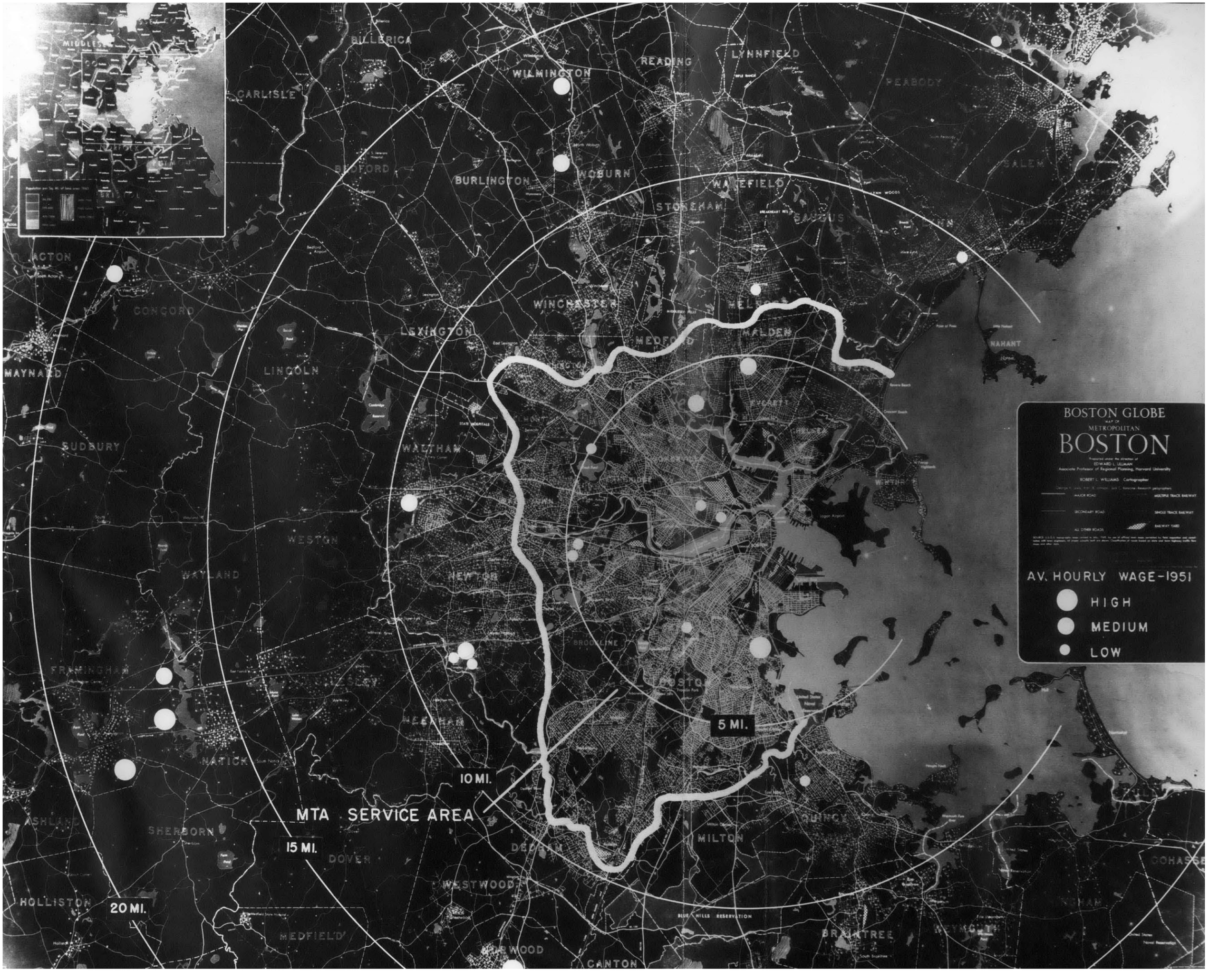
2


BOSTON GLOBE
MAP OF
METROPOLITAN
BOSTON
Prepared under the direction of
EDWARD L. ULLMAN
Associate Professor of Regional Planning, Harvard University
ROBERT L. WILLIAMS Cartographer
MAJOR ROAD
MULTIPLE TRACK RAILWAY
SECONDARY ROAD
SINGLE TRACK RAILWAY
ALL OTHER ROADS
RAILWAY YARD
BLDG. PERM. VALUE-$
$1,000,000 – ABOVE
750,000 – 1,000,000
500,000 – 750,000
250,000 – 500,000
5 MI.
10 MI.
15 MI.
20 MI.
BILLERICA
CARLISLE
WILMINGTON
READING
LYNNFIELD
PEABODY
SALEM
BEDFORD
BURLINGTON
WOBURN
WAKEFIELD
STONEHAM
SAUGUS
ACTON
CONCORD
LEXINGTON
WINCHESTER
MELROSE
MALDEN
MEDFORD
REVERE
NAHANT
MAYNARD
LINCOLN
SUDBURY
WALTHAM
WESTON
WAYLAND
NEWTON
BROOKLINE
FRAMINGHAM
WELLESLEY
NEEDHAM
NATICK
ASHLAND
SHERBORN
DOVER
DEDHAM
WESTWOOD
MILTON
QUINCY
HOLLISTON
MEDFIELD
CANTON
BRAINTREE
HINGHAM
COHASS

MAP

WAGE LEVELS RELATED TO
PLANT LOCATIONS

3


BOSTON GLOBE
MAP OF
METROPOLITAN
BOSTON
Prepared under the direction of
EDWARD L. ULLMAN
Associate Professor of Regional Planning, Harvard University
ROBERT L. WILLIAMS Cartographer
MAJOR ROAD
MULTIPLE TRACK RAILWAY
SECONDARY ROAD
SINGLE TRACK RAILWAY
ALL OTHER ROADS
RAILWAY YARD
AV. HOURLY WAGE-1951
HIGH
MEDIUM
LOW
MTA SERVICE AREA
5 MI.
10 MI.
15 MI.
20 MI.
BILLERICA
WILMINGTON
READING
LYNNFIELD
PEABODY
SALEM
CARLISLE
BEDFORD
BURLINGTON
WOBURN
WAKEFIELD
STONEHAM
SAUGUS
NAHANT
ACTON
CONCORD
LEXINGTON
WINCHESTER
MELROSE
MEDFORD
MALDEN
EVERETT
LINCOLN
MAYNARD
SUDBURY
WALTHAM
WESTON
WAYLAND
NEWTON
BROOKLINE
FRAMINGHAM
WELLESLEY
NEEDHAM
NATICK
ASHLAND
SHERBORN
DOVER
DEDHAM
WESTWOOD
MILTON
QUINCY
HOLLISTON
MEDFIELD
CANTON
BLUE HILLS RESERVATION
BRAINTREE
HINGHAM

Location Characteristics

A. Population

In Part I the broad relationships between new industrial construction and population were observed. In this section the attempt was made to show this relationship in more detail. However, due to the very uneven distribution of population within the municipalities where these 29 industries located during the study period, it was not feasible to use the data which were on municipal or even census tract levels. From the plant locations as indicated on Map (2), page 43, it is possible to see fairly well the physical relationship of these sites to concentrations of population.

Despite the poor quality of reproduction of this population spot map, it does show quite well the close relationship of many of these sites to the major grouping of dots in each municipality. Each dot represents 100 persons.

In general, the plant location pattern closely coincides with that of population concentrations. In but one instance, in Wilmington, 14 miles from the metropolitan center, did the plant locate in a predominately open area. The rest were found either within or in close proximity to these concentrations.

B. Tax Rate

The tax rates of the municipalities in which plant locations were made appear to have relatively little relationship to site selection. Graph (d), page 47, reveals that 51 percent of the projects were undertaken in municipalities which had a tax rate lower than the average six year rate of the BMA, and 49 percent had higher rates. In fact, those projects with the highest dollar value of construction were found to be, in general, in municipalities having the highest rates.

It should be recognized that assessment policies may well have been more of a factor in many instances. Special exemption practices likewise fall in this category. Table 6, page 46, shows the tax rate picture for the 17 municipalities where new plants were located.

TABLE 6

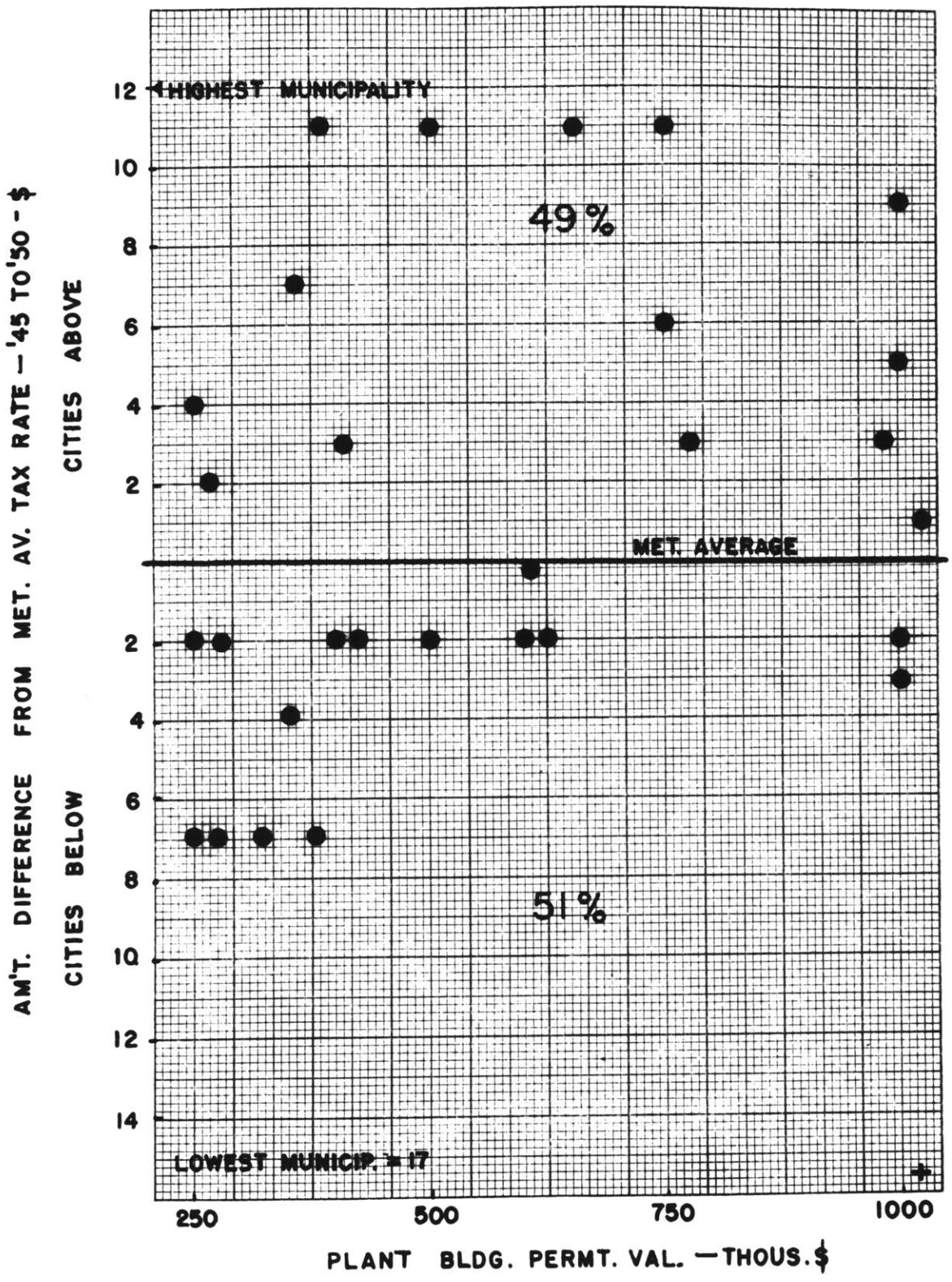
Tax Rates of Municipalities Where 29 Industries Located

1946-1951

Municipality	No. Projects	Rate - $* 1945	Rate - $* 1950	% Inc.	Relation** to BMA Av.
Boston	4	42.5	63	48	+11
Cambridge	5	35.9	39.7	11	- 2
Concord	1	33.6	53	60	+ 6
Danvers	1	42	49	17	+ 9
Framingham	1	32.8	44	34	+ 1
Malden	1	39.8	47.8	20	+ 4
Medford	1	38	51.8	36	+ 7
Melrose	1	29.6	42	41	- 3
Lynn	1	32.8	54.	65	+ 2
Natick	2	34	45.6	33	+ 3
Newton	4	26.8	36	32	- 7
Norwood	2	31.5	39.9	26	- 2
Quincy	1	30	45.2	50	- 4
Waltham	1	34.6	46	33	+ 3
Watertown	1	34	41	21	0
Wilmington	1	42	56	33	+ 5
Woburn	1	32	41.8	31	- 2

* Data from Financial Statistics of Massachusetts - Tyler and Co., Inc.

** BMA average for years 1945-1950 was $39.70. Fifteen plants located in municipalities below the average and fourteen were above.



GRAPH — D

RELATIONSHIP BETWEEN TAX RATE & PLANT LOCATION

d

C. Existing Industry

In attempting to relate the new site locations to industrial agglomerations in more detail, the same problem was encountered as in the population relationship. The major concentrations were not known in most instances, and time considerations prevented more intensive research or survey into the matter. This necessitated the use of the data which were available on the municipal level, and on Map (4), page 49, the plants locations were identified on a base map of municipalities rated according to their amounts of manufacturing employment in 1945. The industrial activity scale is based on increments of 1000 employees.

While not being as detailed as was desired, the relationship of these new locations to municipalities which were ranked according to their relative degree of industrial activity is apparent. In Part I the relationship with groups of municipalities was noted. In most instances the locations were made either within or in close proximity to cities and towns which had considerable industrial activity. Only one, in Concord, located in the area of lowest industrial activity and was at a considerable distance from the next higher ranking municipality.

MAP

PLANT LOCATION RELATIONSHIP
TO EXISTING INDUSTRY

4

BOSTON GLOBE

MAP OF

METROPOLITAN

BOSTON

Prepared under the direction of

EDWARD L. ULLMAN

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ROBERT L. WILLIAMS Cartographer

George K. Lewis, Alan S. Johnson, Jack C. Ransome—Research geographers

MAJOR ROAD

SECONDARY ROAD

ALL OTHER ROADS

MULTIPLE TRACK RAILWAY

SINGLE TRACK RAILWAY

RAILWAY YARD

SOURCE: U.S.G.S. topographic maps revised to Jan., 1949, for use of offset in town maps corrected for field inspection and small tables with town populations, for streets outside built up areas. Classification of roads based on state and other highway traffic flow maps and other data.

INDUST. ACTIVITY

HIGH

LOW

SEE TEXT FOR SOURCE

MIDDLESEX

BILLERICA

CARLISLE

WILMINGTON

READING

LYNNFIELD

SALEM

BEDFORD

BURLINGTON

WOBURN

STONEHAM

MALDEN

SAUGUS

ACTON

CONCORD

LEXINGTON

WINCHESTER

MELROSE

NAHANT

REVERE

MAYNARD

LINCOLN

WALTHAM

SUDBURY

WESTON

WAYLAND

BROOKLINE

NEWTON

NEEDHAM

NATICK

SHERBORN

DOVER

DEDHAM

MILTON

WESTWOOD

HOLLISTON

MEDFIELD

BRAINTREE

COHASSET

GENERAL SUMMARY AND CONCLUSIONS

(1) Summary of Significant Findings in Part I

A. During the years 1946-1951 considerably more industrial construction took place in the metropolitan area outside Boston's Central Core than in the Core. This relationship was found both in respect to absolute number and in proportion to their amounts of 1945 population and industry.

B. The larger share of this disproportionate amount occurring in the area outside the Core was found in the Intermediate Ring, the area lying between 6 and 15 miles from the metropolitan center.

C. The most dominant direction, in terms of new industrial construction activity, was West.

D. The larger industrial projects, in terms of dollar value of construction, were located outside the area 6 miles from the metropolitan center.

E. In the relatively large areal designations employed in this study, the closest relationship involving industrial construction was with population gain which occurred in these areas during the years 1945-1950 rather than 1945 population or industry.

(2) Summary of Significant Findings in Part II

A. The strongest relationships of "industrial factors" to distance from the metropolitan center were with:

1. Intensity of Land Use, as measured by floor area ratio.
2. Type of Product
3. Level of Building Investment

B. The following factors showed a considerably lower but still discernible relationship to distance:

1. Wage Level
2. Space Requirements per Employee

In both of these cases the small size of the sample limits the validity of the comparison, and in the first instance, estimated data was utilized.

C. An observation of three characteristics of the areas where new plants located revealed a relatively close relationships between the new sites and population and industrial concentrations. These industries were not, to any marked extent located in municipalities which had lower than average tax rates.

(3) General Conclusions

The kinds of information obtained through the pursuit of this analysis have value, I believe, in many aspects of the metropolitan planning process. While the factual information presented here is basically of two different types, the one being general in its implications and the other a selective sampling of the numerous areas for research in the field of industrial location and planning, both would be particularly useful when applied to such phases of metropolitan planning as transportation, public utilities, etc. The broad implications of locational trends which are apparent in Part I, when based on more thorough and intensive research, are significant factors in all phases of land use planning on the metropolitan level.

The factual material presented here, as it applies to the Boston Metropolitan Area, could have value as a practical planning tool if it were made the basis for more intensive research and investigation

along similar lines and were there an existing effective agency to use it.

It was observed during the course of this study that most of the factors relating to plant location which were analyzed, certain of which were very superficially explored, would be excellent subjects for more detailed research and statistical analyses. Perhaps companion studies, covering the same general field but analyzing different groups of the very numerous factors in this complex process, would prove fruitful, if these studies could be an integral part of a comprehensive research project. Some of the material derived from the analysis presented here could conceivably be useful in comparison studies with similar material from other metropolitan areas with the objective of trying to discover general practices and trends. In one of the above mentioned roles it seems this essentially factual thesis would find its greatest value.

APPENDIX A:

A TABLE OF BASIC DATA USED IN THIS STUDY ... The 100 cities and towns covered in this study are listed according to their Ring and Group divisions. The following data are shown for these municipalities:

a. Dollar value of industrial construction - 1946-1951
b. Number construction projects - 1946-1951
c. Capital invested in manufacturing - 1945
d. Number of employed in manufacturing - 1945
e. Number of manufacturing establishments - 1945

SOURCES:

a and b: Reports of building permit applications compiled by Department of Labor and Industries - Division of Statistics and annual surveys of new industrial construction published in the magazine Industry by The Associated Industries of Massachusetts.

c, d and e: Census of Manufactures, Massachusetts Department of Labor and Industries - Division of Labor Statistics.

	INDUST. CONSTRUCTION 1946-1951		GEN. INDUST. ACTIVITY 1945		
	$ Value (thous.)	Number of Projects	Cap. Inv. (thous. $)	Number Employees	Number Estab.
CENTRAL CORE					
Boston	8,429	102	338,447	80,898	2,454
Brookline	17	3	1,338	272	25
Cambridge	8,064	91	128,653	20,800	353
Chelsea	336	8	17,038	3,590	97
Everett	1,623	7	74,180	5,497	102
Somerville	855	18	27,335	6,011	145
	19,324	226	586,991	117,068	3,176
RING 2, Intermed.					
NE Group					
Beverly	364	6	18,266	3,088	41
Danvers	1,249	10	4,610	2,277	26
Lynn	3,979	39	71,058	29,000	282
Lynnfield	0	0	*	*	*
Marblehead	0	0	609	167	13
Nahant	0	0	0	0	0
Peabody	433	30	27,210	4,932	99
Revere	488	6	970	433	24
Salem	687	15	34,249	6,415	110
Saugus	0	0	968	173	15
Swampscott	0	0	*	*	*
Winthrop	0	0	*	*	*
	7,200	106	158,644	46,605	626
No. Group					
Malden	419	17	20,746	4,661	113
Medford	1,316	18	5,608	1,549	30
Melrose	1,500	1	1,258	403	22
Reading	15	1	1,873	302	13
Stoneham	47	2	1,507	502	13
Wakefield	151	4	5,000	1,955	39
Winchester	40	4	3,586	946	14
Woburn	1,054	5	8,296	1,132	37
	4,542	52	47,874	11,450	301

* Information witheld to avoid disclosure of individual concerns. Amounts are figured in group totals.

	INDUST. CONSTRUCTION 1946-1951		GEN. INDUST. ACTIVITY 1945		
	$ Value (thous.)	Number of Projects	Cap. Inv. (thous. $)	Number Employees	Number Estab.
NW Group					
Arlington	91	4	619	207	21
Belmont	1,950	1	145	40	5
Lexington	0	0	*	*	*
Newton	3,429	40	15,879	4,986	61
Waltham	2,589	44	45,796	9,730	108
Watertown	1,440	27	20,282	6,081	73
	9,510	116	82,866	21,103	272
SW Group					
Dedham	7	1	1,042	193	8
Needham	385	16	2,472	626	30
Norwood	823	11	16,679	3,416	23
Wellesley	0	0	913	251	8
Westwood	0	0	*	*	*
	1,215	28	21,119	4,488	70
So. Group					
Abington	0	0	2,120	571	9
Avon	77	4	*	*	*
Brockton	143	7	28,465	8,711	204
Canton	212	2	11,259	3,255	19
Holbrook	0	0	1,345	260	6
Milton	36	1	*	*	*
Randolph	0	0	206	230	6
Stoughton	108	5	5,687	1,770	26
Whitman	0	0	4,159	1,374	16
	576	19	54,094	16,374	296
SE Group					
Braintree	590	5	8,409	1,487	17
Cohassett	0	0	*	*	*
Hingham	47	3	*	*	*
Hull	0	0	*	*	*
Quincy	1,096	10	27,056	17,471	117
Rockland	0	0	3,867	1,215	16
Weymouth	0	0	2,808	932	19
	1,733	18	53,564	26,375	180

* Information witheld to avoid disclosure of individual concerns. Amounts are figured in group totals.

	INDUST. CONSTRUCTION 1946-1951		GEN. INDUST. ACTIVITY 1945		
	$ Value (thous.)	Number of Projects	Cap. Inv. (thous. $)	Number Employees	Number Estab.
RING 3, Outer					
NE Group					
Essex	0	0	0	0	0
Gloucester	1,294	6	8,958	1,156	40
Hamilton	0	0	0	0	0
Ipswich	0	0	*	*	*
Manchester	0	0	*	*	*
Middleton	3	1	*	*	*
Rockport	0	0	*	*	*
Topsfield	0	0	*	*	*
Wenham	13	2	0	0	0
	1,310	9	13,916	2,736	60
No. Group					
Burlington	0	0	*	*	*
No. Reading	0	0	*	*	*
Wilmington	400	1	*	*	*
	400	1	316	111	5
NW Group					
Acton	115	4	429	94	7
Bedford	0	0	*	*	*
Carlisle	0	0	0	0	0
Concord	530	3	599	194	8
Lincoln	0	0	0	0	0
Maynard	0	0	*	*	*
Sudbury	0	0	*	*	*
Wayland	0	0	0	0	0
Weston	0	0	0	0	0
	645	7	14,854	1,671	24

* Information witheld to avoid disclosure of individual concerns. Amounts are figured in group totals.

	INDUST. CONSTRUCTION 1946-1951		GEN. INDUST. ACTIVITY 1945		
	$ Value (thous.)	Number of Projects	Cap. Inv. (thous. $)	Number Employees	Number Estab.
SW Group					
Ashland	0	0	4,263	1,385	8
Dover	0	0	*	*	*
Framingham	3,309	8	16,587	3,207	39
Holliston	14	5**	1,057	353	8
Medfield	0	1***	*	*	*
Medway	0	1***	1,165	382	6
Millis	0	0	3,626	460	5
Natick	8,330	4	2,107	689	22
Norfolk	0	0	*	*	*
Sherborn	0	0	*	*	*
Walpole	455	3	12,734	1,841	17
	12,108	22	42,393	8,635	112
So. Group					
Bridewater	81	3	3,074	828	11
E. Bridgewater	0	0	1,034	323	9
Easton	0	0	2,224	502	9
Foxboro	739	7	*	*	*
Mansfield	210	7	7,695	1,067	14
Sharon	0	0	*	*	*
W. Bridgewater	0	0	*	*	*
	1,030	17	20,550	3,734	51
SE Group					
Duxbury	0	0	0	0	0
Halifax	0	0	0	0	0
Hanover	0	0	*	*	*
Hanson	15	1	*	*	*
Marshfield	0	0	*	*	*
Norwell	0	0	*	*	*
Pembroke	10	1	*	*	*
Scituate	0	0	*	*	*
	25	2	14,556	3,057	13

* Information witheld to avoid disclosure of individual concerns. Amounts are figured in group totals.

** 2 with no estimate

*** 1 with no estimate

Appendix B:

REFERENCES AND SOURCES

Census of Manufactures - Massachusetts Department of Labor and Industries - Division of Labor Statistics

Directory of Manufactures - Commonwealth of Massachusetts

Financial Statistics of Massachusetts - Tyler and Company, Inc.

Associated Industries of Massachusetts

Cabot, Cabot, and Forbes; Industrial Realtors and Developers

Massachusetts Department of Labor and Industries - Division of Labor Statistics

Massachusetts Development and Industrial Commission

Massachusetts Division of Employment Security

Massachusetts State Planning Board

Federal Reserve Bank of Boston - Department of Statistics